Tappi

PUBLISHED BY THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY

MAY 1950

NOW—a defoamer in handy 2½-lb. bricks!

THIS SIDE UP · STORE IN A COOL PLACE
HERCULES
DEFOAMER 4
PAT. APPLIED FOR
PAPER MAKERS CHEMICAL DEPARTMENT
HERCULES POWDER COMPANY
INCORPORATED
WILMINGTON · DELAWARE
HERCULES POWDER COMPANY MAKES NO WARRANTY, EXPRESS OR IMPLIED, WITH RESPECT TO THE USE OF THIS MATERIAL.
NET WEIGHT 2½ LBS.
STORE IN A COOL PLACE
HERCULES
DEFOAMER 4
PAPER MAKERS CHEMICAL DEPARTMENT
HERCULES POWDER COMPANY
WILMINGTON · DELAWARE

Now you can buy your defoamer in easy-to-handle, easy-to-use bricks! No waste! No mess! No heavy drums to handle or ship back! Bricks quickly dissolve in water. One 2½-lb. brick of Defoamer 4* makes 40 gallons. Try this new, low-cost Hercules product today at our expense, and be convinced of its convenience and economy. Send for free sample brick.

HERCULES POWDER COMPANY 967 King St., Wilmington 99, Delaware

— NO DRUMS TO HANDLE

— EASY TO USE, EASY TO STORE

— ONE BRICK MAKES 40 GALLONS

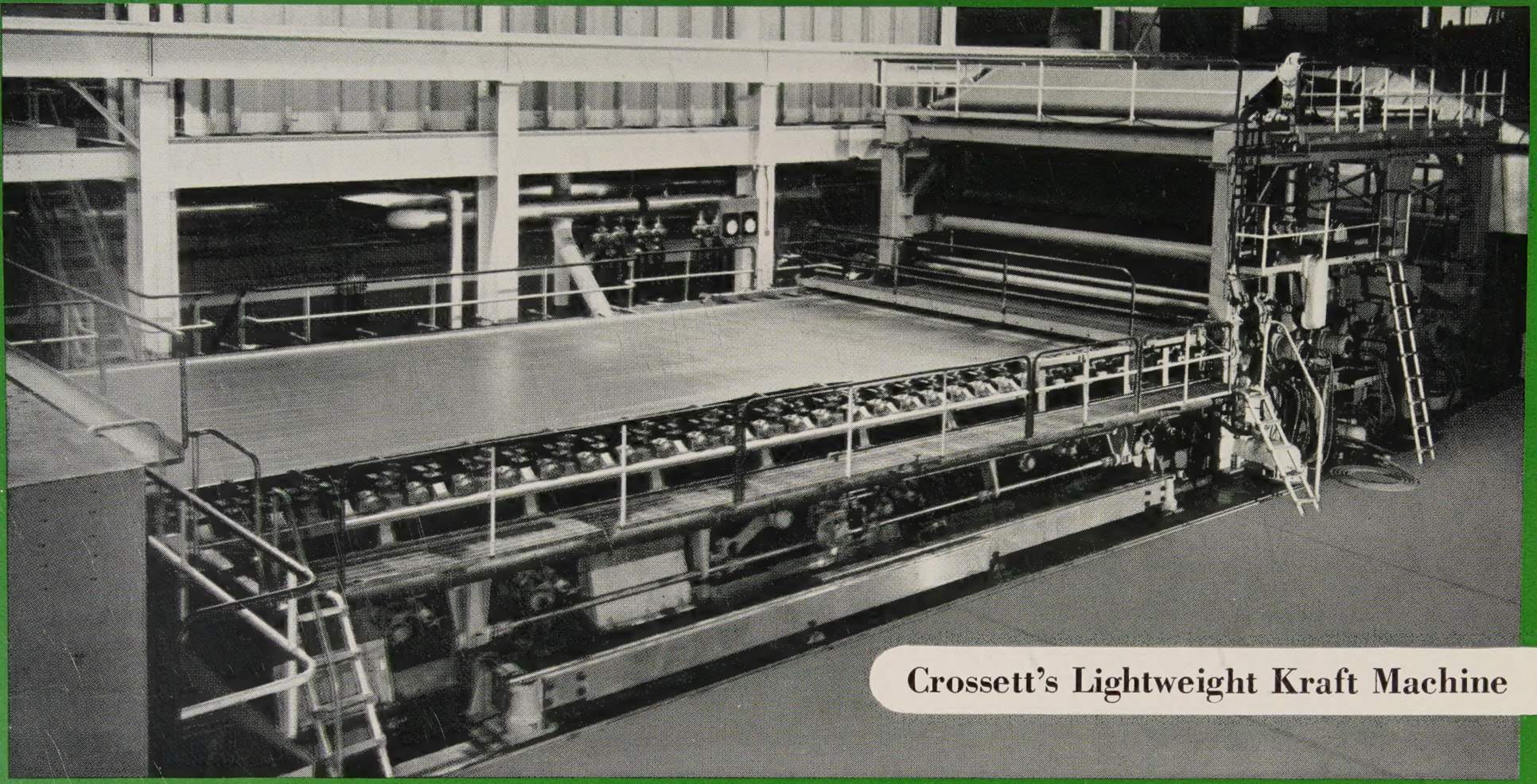
— FREE SAMPLE BRICK ON REQUEST

HERCULES

SIZING MATERIALS AND CHEMICALS FOR PAPER

*PAT. APPLIED FOR

PP50-3



Crossett's Lightweight Kraft Machine

Congratulations to Crossett . . .

When Crossett Paper Mills, Crossett, Arkansas, started its new Beloit High Speed Kraft machine on January 17, 1950, a new era in lightweight paper manufacture began. Many features of machine and mill design have contributed to this highly successful start-up, among them being the new automatic transfer arrangement which removes the sheet from the Fourdrinier wire and carries it through the press section. From the start, operating speeds have been maintained at levels definitely higher than had previously been possible.—*Beloit Iron Works, Beloit, Wisconsin.*

PULP WOOD TO COLORED PAPER

Rely on National Aniline Technical Service

for development of economical color formulae to suit the use requirements of the types of paper and board desired.

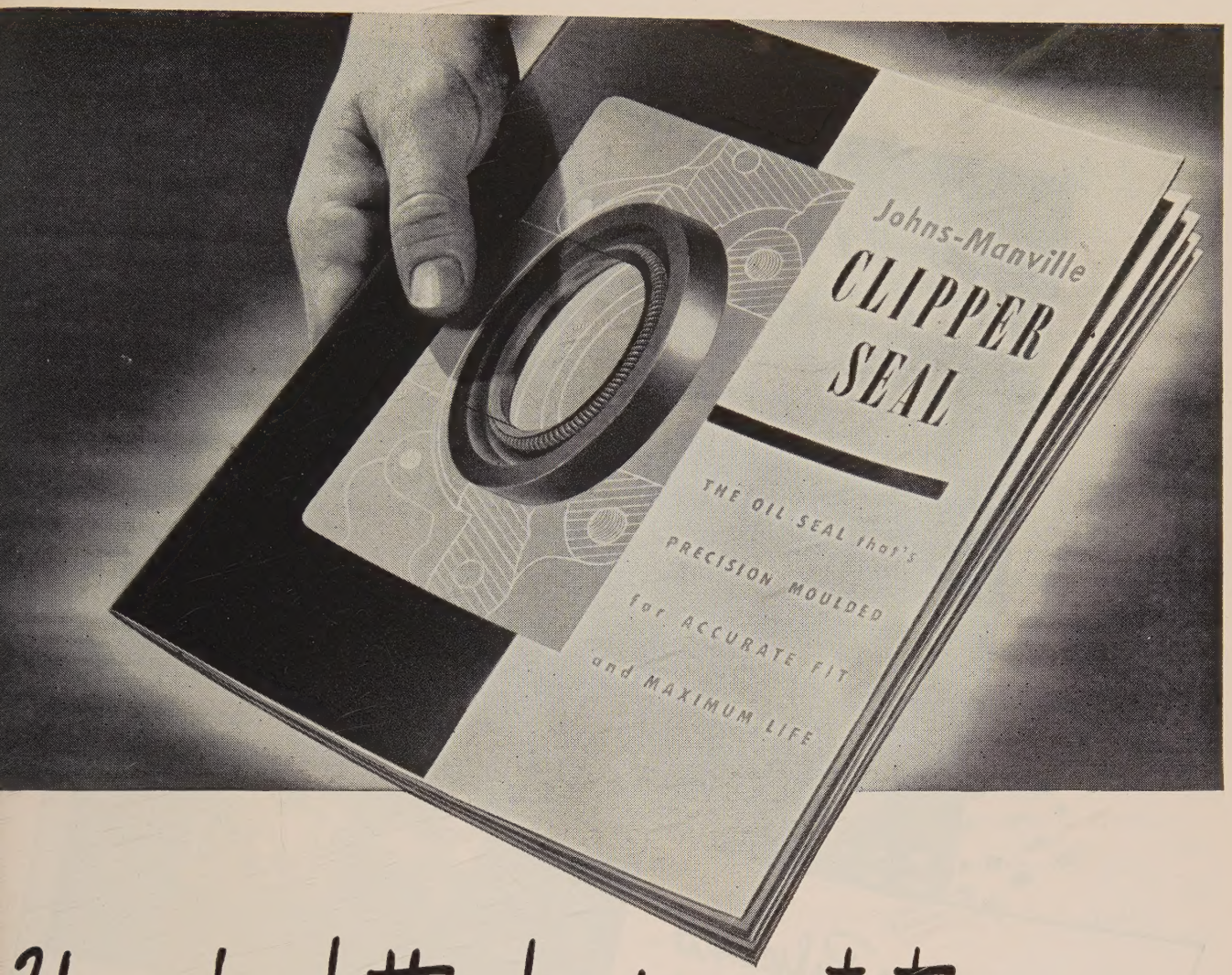
for assistance in duplicating our laboratory formulations efficiently in the mill.

For the best dyes
backed by National service,
write, wire or phone our nearest office.

National Aniline PAPER DYES

NATIONAL ANILINE DIVISION
Allied Chemical and Dye Corporation
40 Rector Street, New York 6, N. Y.

BOSTON • PROVIDENCE • PHILADELPHIA • CHICAGO • SAN FRANCISCO • PORTLAND, ORE
GREENSBORO • CHARLOTTE • ATLANTA • NEW ORLEANS • CHATTANOOGA • TORONTO



Yours for better bearing protection

—this new book about OIL SEALS

Here is a book filled with useful data about oil seals that you're sure to want for your files. It gives the complete story of the Johns-Manville Clipper Seal . . . tells how this precision oil seal with the one-piece moulded body is providing better bearing protection at lower cost in many types of applications.

Here you will find photographs and diagrams of typical Clipper Seal installations; information on the various lip designs that provide a choice of bearing surfaces; the wide range of sizes that are available; the thick or thin flanges designed for the precision sealing in many bearing housings.

Here are Clipper Seals that help cut maintenance costs and down time . . . seals that are designed specially for quick, easy application where space is limited . . . for resistance to corrosive attack . . . for high temperature operation and other special conditions.

Whether you are concerned with the design or maintenance of equipment, this new Clipper Seal book can help you get better bearing protection at lower cost. Send for your copy today.

JUST FILL IN THE COUPON BELOW

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville CLIPPER SEALS

Johns-Manville
Box 290, New York 16, N. Y.
Please send me the new Clipper Seal Book (PK-46A).

Name_____

Company_____ Position_____

Address_____

City_____ State_____

To men of the Pulp and Paper industry interested in the alkaline pulping process...

DORR OFFERS... Bulletin #3301, containing twelve pages of photos, diagrammatic sketches and text descriptive of the Dorr Continuous Recausticizing System. A copy is yours for the asking.

DORRCO

THE DORR COMPANY, ENGINEERS
BARRY PLACE, STAMFORD, CONN.

NEW YORK • ATLANTA • TORONTO
CHICAGO • DENVER • LOS ANGELES

RESEARCH AND TESTING LABORATORIES
WESTPORT, CONN.

SUGAR PROCESSING
PETREE & DORR DIVISION, STAMFORD, CONN.

ASSOCIATES AND REPRESENTATIVES
Dorr Technical Services and Equipment Are Also Available Through Associated Companies and Representatives in the Principal Cities of the World
Names and Addresses on Request.

DORR

RESEARCH ENGINEERING EQUIPMENT

MAY 1950

Tappi

VOL. 33 · NO. 5

Published monthly by the Technical Association of the Pulp and Paper Industry

Editor

R. G. MACDONALD

Assistant Editor

R. T. Bingham

Publication Management Committee

K. P. Geohegan, *Chairman*
H. W. Bialkowsky
Werner Kaufmann
R. W. Kumler
R. P. Price

Editorial Board

C. J. West, *Chairman*
S. I. Aronovsky
J. F. Campbell
J. d'A. Clark
E. L. Cowan
R. F. DeLong
A. S. Erspamer
R. C. Griffin
W. D. Harrison
Emil Heuser
W. F. Holzer
E. C. Jahn
H. F. Lewis
J. D. Malcolmson
H. Mark
A. E. Montgomery
D. G. Moon
J. L. Parsons
Henry Perry
A. L. Sherwood
Edwin Sutermeister
G. H. Tomlinson II
B. L. Wehmhoff

TECHNICAL ARTICLES

The Effect of Kraft Pulp Mill Wastes on Fish Life, *by Willis M. Van Horn, J. B. Anderson, and Max Katz* 209
Casein Adhesives in Roll Coating, *by J. Wilson Smith, Richard T. Trelfa, and Harris O. Ware* 212
Effect of Phenolic Resins on Physical Properties of Kraft Paper, *by Parker K. Baird, Robert J. Seidl, and Donald J. Fahey* 219
Penetration of Neutral Sulphite Cooking Liquors into Yellow Birch Wood, *by Victor J. Wirpsa and C. E. Libby* 225
Neoprene Latex in the Paper Industry, *by R. H. Walsh, H. H. Abernathy, W. W. Pockman, J. R. Galloway, and E. P. Hartsfield* 232
Deinking Studies IV. Selective Screening and Refining as Applied to Partially Deinked Stock, *by H. P. Bailey, J. J. Forsythe, and J. F. Tomaszewski* 238
Utilization of Methoxy Lignin Chloride by Resinification, *by Raphael Katzen, Irving Krushel and Donald F. Othmer* 244
Utilization of Cellulose from Methanol-Chlorination of Wood, *by R. Katzen, R. S. Aries, Kjell Goranson, and D. F. Othmer* 246
Eucalypt Pulps from Water Prehydrolysis and Sulphate Pulping, *by Alexander Meller* 248
Enzyme Conversion of Starch for Paper Coating, *by D. A. Hughes and W. L. Craig* 253

DEPARTMENTS

Editorial Comment ..... 6 A
Container Symposium ..... 14 A
An Unscientific Way to Scientific Help in Packaging, *by C. S. Macnair* ... 14 A
Some Aspects of Container Handling in Rail Transportation, *by Edward J. Dahill* ..... 20 A
Quality Control of Corrugated Shipping Cases from a Buyer's Viewpoint, *by E. H. Balkema* ..... 26 A
Controlling Container Quality, *by G. A. Farrah* ..... 32 A
Association News and Events ..... 38 A
The Role of the Chemical Engineer in the Pulp and Paper Industry, *by G. W. E. Nicholson* ..... 42 A
Plastics and Paper Converting-Review of Literature for 1948 ..... 48 A
Personal Mention ..... 57 A
Obituary ..... 60 A
Local Section Activities ..... 62 A
United States Patents on Papermaking, Third Quarter, 1949 ..... 85 A
Letters to the Editor ..... 91 A
Recent Books ..... 92 A
Reports and Discussions ..... 93 A
Technology in the Japanese Pulp and Paper Industry, *by H. E. Murdock* 97 A
Machine Production Possibilities, *by J. E. Goodwillie* ..... 99 A
Employment Service ..... 102 A
Calendar of TAPPI Meetings ..... 103 A

Published monthly by the Technical Association of the Pulp and Paper Industry at 20th and Northampton Streets, Easton, Pa. Editorial and advertising offices, 122 East 42nd Street, New York 17, N. Y. Articles for publication and communications regarding the editorial content of *Tappi* should be addressed to the Editor at the editorial office. Statements and opinions expressed in articles and editorials appearing in *Tappi* are those of the contributors, and the Technical Association of the Pulp and Paper Industry assumes no responsibility for them. Subscription: U. S. and possessions, $7.50; Canada, $8.25; Pan American Union, $9.00; Other Foreign, $10.00. Single copies to members of TAPPI, $0.75; Nonmembers, $1.00. Entered as second class matter January 27, 1949, at the Post Office at Easton, Pa., under the act of August 24, 1912. Copyright, 1950, by the Technical Association of the Pulp and Paper Industry. An index of the technical articles appearing in the magazine appears in the Industrial Arts Index and the Engineering Index.

EDITORIAL Tappi COMMENT

Functional Conferences

This year the Technical Association reverts to its practice of holding several functional conferences rather than a general fall convention such as was held last year in Portland, Ore. In a sense a general meeting such as the annual meeting is a composite of several functional sessions.

An understandable criticism of a general meeting is the inability of many members to attend. In most cases only a few individuals can be sent by their companies to attend any meeting. By having a number of intensively organized functional meetings, aside from the annual meeting, it is possible for companies to send more representatives during the series and for them to know that their representatives will benefit to a great extent.

The functional conferences this year will be sponsored by the Association's Fundamental Research, Testing, Engineering, Alkaline Pulping, Plastics, and Fibrous Agricultural Residues Committees.

Fundamental Research Conference

The first of these conferences will be held jointly with the C.P.P.A. Technical Section at the Chateau Frontenac in Quebec, P. Q. The TAPPI sponsor will be its Fundamental Research Committee of which Harry F. Lewis of the Institute of Paper Chemistry is chairman. Dr. Lewis' committee has sponsored similar meetings at Detroit, Appleton, and Madison with outstanding results.

Dr. Lewis frequently has advocated that the Fundamental Research Committee, as such, be discontinued and that many of our committees establish fundamental research subcommittees. This would be an ideal arrangement if it would work and there has been no restriction in the past to the establishment of such subcommittees. Consequently, it is obvious that the Association is greatly indebted to Dr. Lewis and his committeemen for the leadership that they have provided in focusing attention on the problems of fundamental research in the various fields.

At the Quebec meeting the Committee will invade a field that complacently, may have felt that it would be free from such intrusion for many years. It has been a field dominated since T'sai Lun's time by art and know-how. It is the field of stock preparation and papermaking itself. The cellulose fiber has been very accommodating over the years. If properly treated, mechanically, it joins with other fibers in making a sheet of paper. Art and know-how have produced a wide variety of papers of many degrees of quality. The Quebec meeting should do much to create a better understanding of the nature of the cellulose fiber as a papermaking agent.

Expansion in Pulp and Paper Education

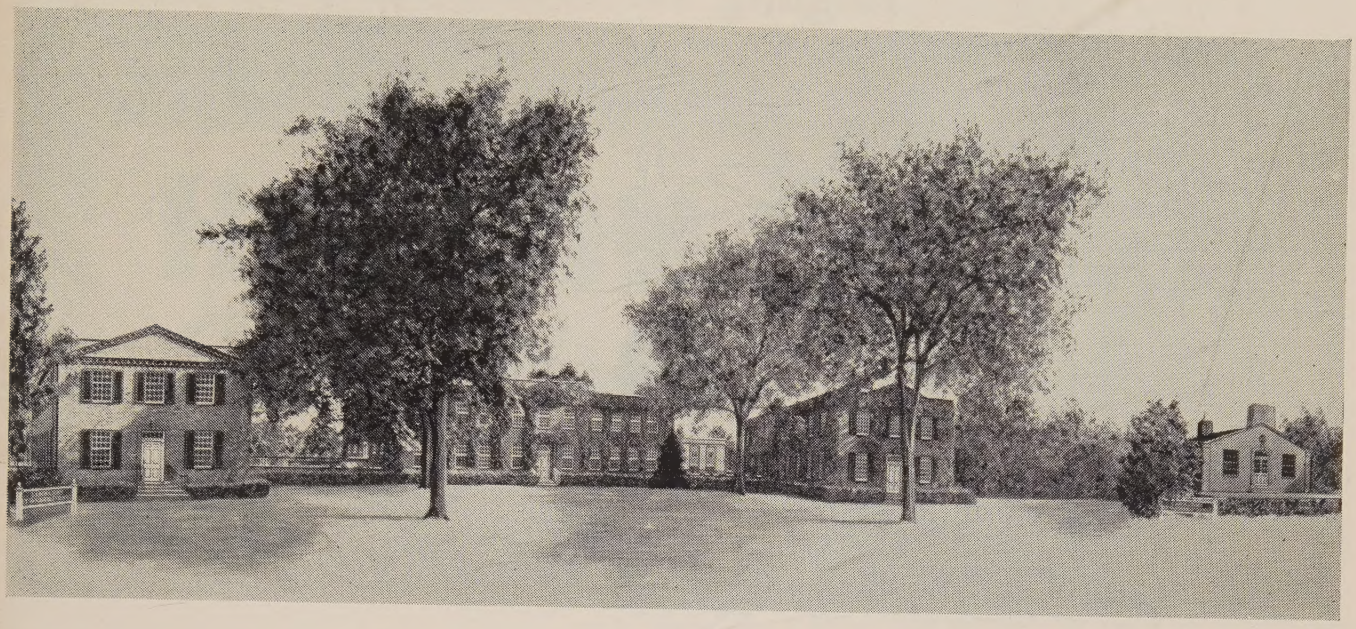
Since the turn of the year attention has been drawn toward the activities in at least four colleges that feature undergraduate work in preparation for employment in the pulp and paper industry.

During the annual meeting of TAPPI the alumni groups of the University of Maine, and the New York State College of Forestry were electrified in enthusiasm by the presentation of plans for the enlargement and revitalization of the facilities at these famous institutions and their proposed industrial cooperation programs.

In March, at the meeting of the New England Section of TAPPI, the plans of the Lowell Textile Institute were revealed and thoroughly discussed. This school which has been and is a leader in textile technology education announced its elaborate and well-financed plan to serve two other great industries in Massachusetts—those of pulp and paper and leather manufacture.

In April the new facilities of the Pulp and Paper Division of Western Michigan College in Kalamazoo were dedicated. The Kalamazoo Valley Section of TAPPI and the Michigan Division of the Superintendents Association participated jointly in signalizing this important event. Its Graphic Arts Conference symbolized one of the great objectives of such an institution. Western Michigan College has been devoted to the training of educators. It is the first institution of its kind to recognize the importance of the printed word to the extent of devoting some of its educational program to the principal medium of education—Paper, on which the accepted ideas of teachers of all kinds are impressed by the graphic arts and passed on to the student.

The justification for these specific endeavors remain to be seen. They are by their very nature, speculative. The leaders in these institutions see an opportunity to be of service to a wide-awake, vital, and growing industry—an industry that is consuming more and more horsepower of electrical energy—and consequently an industry that needs the highest quality of administration and supervision of technically trained men. Our best wishes are extended to them.



THE VANDERBILT LABORATORIES

Norwalk, Conn.

★

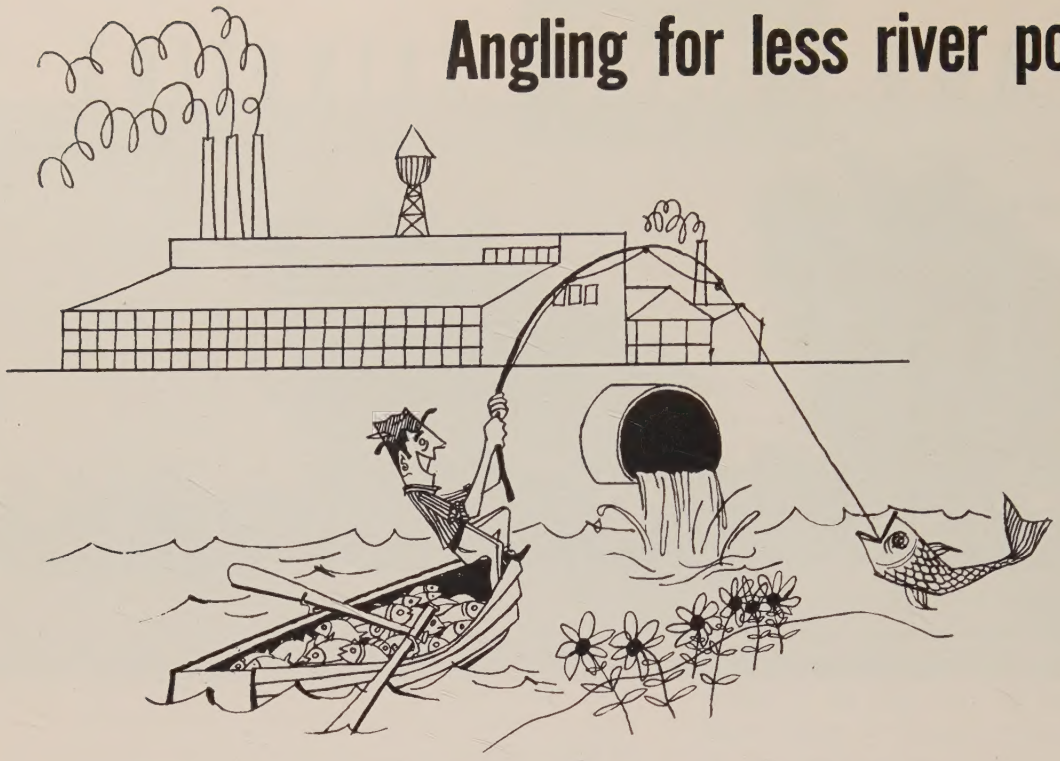
For Testing and Developing
Methods of Improving
Paper Products

★

R. T. VANDERBILT CO., INC.

230 Park Avenue, New York City

Angling for less river pollution?



Cyanamid's { Sodium Phospho Aluminate / Aluminum Sulfate

offer these important advantages . . .

▶ LESS WASTE DISCHARGED INTO THE RIVER due to excellent retention of filler and fiber—together with ▶ Maximum opacity at low cost ▶ Less corrosion of wire and equipment ▶ Better, more uniform sizing ▶ Lower paper acidity, longer life

YOU GET 100% CONTROLLED QUALITY when you buy from Cyanamid, the *only* producer of these products that controls every stage of the manufacturing process—from mining the raw materials to compounding the finished products.

AMERICAN *Cyanamid* COMPANY

INDUSTRIAL CHEMICALS DIVISION DEPT. T-5
30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

INVESTIGATE TODAY. WRITE FOR FULL INFORMATION.

Essential partner on your fire protection team

A HORTON elevated tank and an automatic sprinkler system form a team that is your best defense against fire. They start to fight back just as soon as a fire breaks out, before it has a chance to spread. They go to work at the heart of a fire, where fighting is most effective, and which often cannot be reached by any other fire-fighting method. A sprinkler system backed by an elevated tank may mean the difference in your plant between a few minutes' interruption and a costly shutdown.

Horton ellipsoidal-bottom elevated steel tanks are built for use with automatic sprinkler systems and for general industrial service in capacities from 15,000 gals. to 500,000 gals. As a result of their butt-welded steel construction, they are smooth, graceful structures which are economically maintained. All parts of the tanks are accessible for inspection and painting.

Why not let this team protect your plant? We shall be glad to submit a quotation on the elevated tank, without obligation to you. Write our nearest office, stating capacity required, location where tank is to be erected, height to bottom, and type of insurance you carry.

The Horton elevated tank shown above is located at the United Wallpaper plant at Montgomery, Illinois. It is a 150,000-gal. unit, 150 ft. to bottom which furnishes 50,000 gals. of water per day for general service, holds 100,000 gals. in reserve at all times for fire protection. The entire plant is protected by a sprinkler system.

CHICAGO BRIDGE & IRON COMPANY

Atlanta, 3 . . . . . 2133 Healey Building
Birmingham, 1 . . . . . 1543 North 50th Street
Boston, 10 . . . . . 1057—201 Devonshire Street
Chicago, 4 . . . . . 2140 McCormick Building
Cleveland, 15 . . . . . 2238 Guildhall Building
Detroit, 26 . . . . . 1548 Lafayette Building
Havana . . . . . 402 Abreu Building
Houston, 2 . . . . . 2156 National Standard Building
Los Angeles, 17 . . . . 1550 General Petroleum Building
New York, 6 . . . . . 3324—165 Broadway Building
Philadelphia, 3 . . . 1642—1700 Walnut Street Building
Salt Lake City, 4 . . . . . 562 West 17th South Street
San Francisco, 11 . . . 1238—22 Battery Street Building
Seattle, 1 . . . . . 1362 Henry Building
Tulsa, 3 . . . . . 1645 Hunt Building

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA. In Canada: HORTON STEEL WORKS LIMITED, FORT ERIE, ONT.

Methocel:

the Well Known Thickener

The outstanding advantage of Methocel (Dow Methylcellulose) as a thickener is that *so little will do so much.* To the paper manufacturer, this quality is highly useful in several ways.

First, Methocel's superior thickening qualities are valuable in the control of latex viscosity. Compatible with practically all natural and synthetic latices, Methocel is the versatile thickener which gives inexpensive, uniform viscosity control.

Second, Methocel is widely used as a sizing. Small quantities of Methocel will impart tack-resistant and grease-proof qualities, particularly useful for packaging of sticky or oily substances. Further, its use in gloss ink sizing and as an offset spray are well known.

Find out now about Methocel, the superior synthetic gum. Try it in your plant and see for yourself its many superior advantages. Send in the coupon for your *free* experimental sample of the *new* Methocel, *powdered.*

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

THE new *Methocel*

DID YOU GET YOUR SAMPLE?

The Dow Chemical Company
Dept. ME-945, Midland, Michigan
Please send free sample of METHOCEL, for use in_____
Check viscosity desired: 15, 25, 100, 400, 1500, 4000 cps.
Name and Title_____
Firm_____
Address_____
City_____ State_____

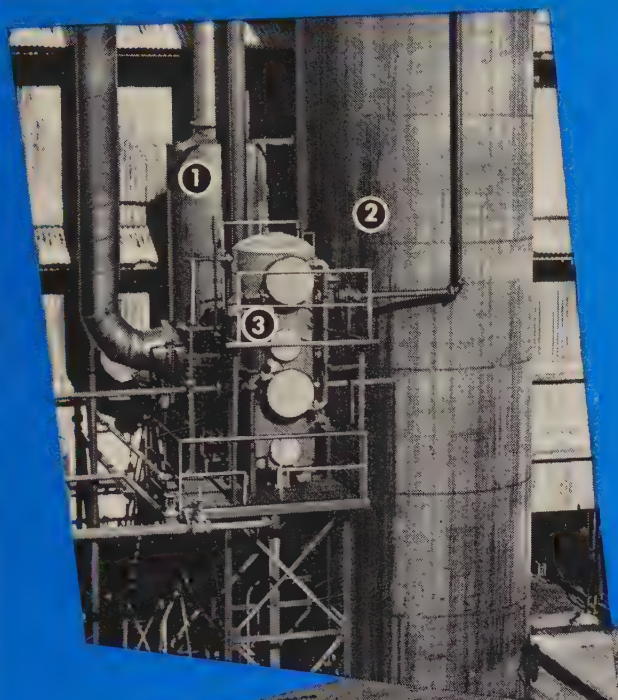
DOW

CHEMICALS

INDISPENSABLE TO INDUSTRY AND AGRICULTURE

harnessing HEAT DOLLARS *at St. Regis*

with FOSTER WHEELER BLOWDOWN RECOVERY SYSTEMS



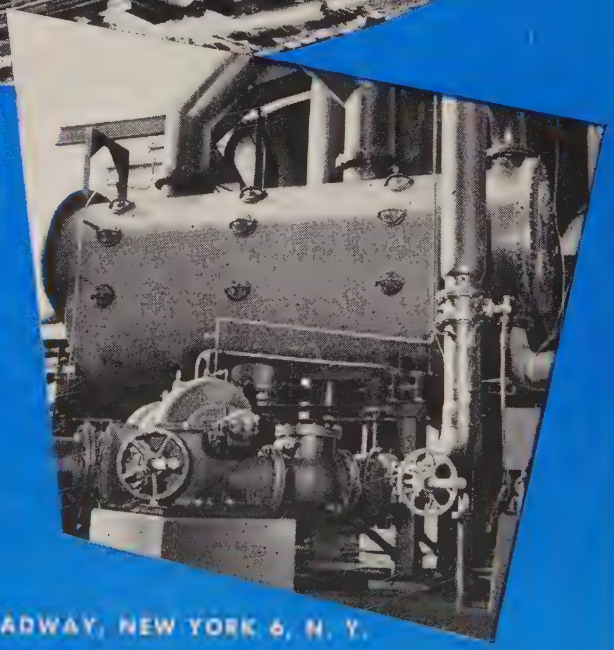
At the St. Regis Paper Mills in Pensacola, Florida, two types of blowdown recovery systems are in operation. In the Vapor-to-Liquid System (left) steam is condensed in the atmospheric condenser (1) and hot condensate is stored in the accumulator tank (2). This condensate, contaminated by some black liquor and pulp, is flashed under vacuum and the resultant clean vapors heat mill water in the tubes of the flash heater (3).

In the Surface Condenser (below) mill water flowing through the tubes is heated by steam condensing in the shell. The expansion chamber or vapor drum provides pure steam resulting tube bundles.

Properly engineered recovery equipment not only *costs you less* in the long run but *increased operating efficiency* and *large fuel savings* may also be enjoyed from the outset.

If you are contemplating improvements at your mill, our specialists on pulp and paper mill equipment will be glad to help you with your engineering problems.

Foster Wheeler Blowdown Recovery Systems are discussed in the May, 1950 issue of *Heat Engineering*. Write for a copy.

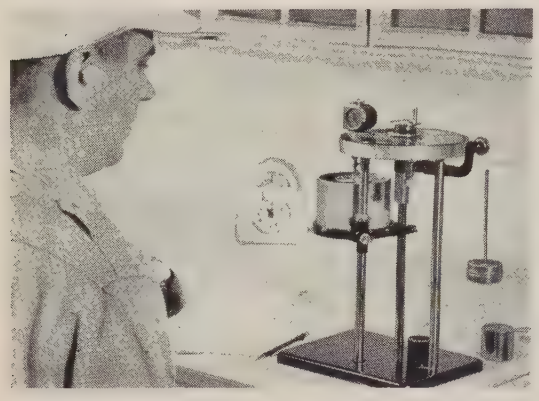


FOSTER WHEELER CORPORATION • 165 BROADWAY, NEW YORK 6, N. Y.

FOSTER WHEELER

KAOLIN CLAY FACTS...*for Paper Makers*

NUMBER 3 OF A SERIES FROM THE J. M. HUBER CORPORATION LABORATORIES



Determining viscosity of clay suspensions with the Stormer Viscometer at the Huber Clay Laboratories.

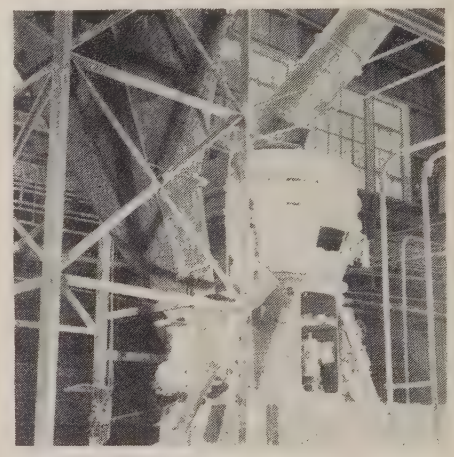
CLAY-WATER SYSTEMS OFFER POSSIBLE STANDARD VISCOSITY TEST FOR COATING MIXTURES. The vast array of coating formulations precludes any standard test formula for viscosity measurements. Clay-water systems, however, offer the best prospect for the establishment of a standard viscosity test. The test is made on a mixture containing 70 per cent clay, dispersed to maximum fluidity with tetrasodium pyrophosphate. A viscosity evaluation of this type is particularly useful in predicting the rate of flow through relatively fine screens in operations which require screening of highly concentrated clay-water systems.

AIR-FLOATED OR WATER WASHED FILLER GRADE CLAY? The competition between the two basic types of filler clay—air-floated and water washed—is keen. As one of the relatively few companies producing both kinds, Huber is thoroughly familiar with the respective merits of each. In general, they are about equal from a quality standpoint with the better grades of air-floated having a slight superiority for some purposes.

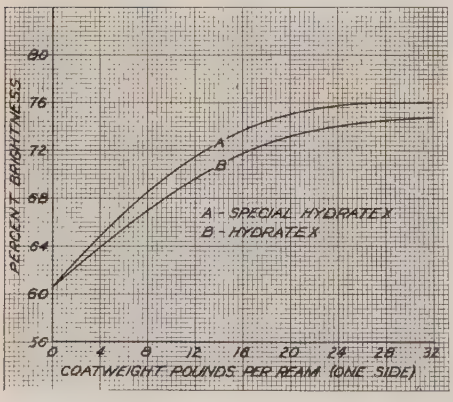
COMPARISON OF FILLER GRADE PAPER CLAYS

	G. E. Brightness	*Screen Residue (325 mesh)*	*Abrasion Test (Wire Loss)*	*Moisture*
Huber Aerfloted Hi-White (Georgia)	80–81%	0.3%	15 mg.	1–2%
Huber Aerfloted Paragon (So. Car.)	79–80	0.4	16	1–2
Huber Water Washed Filler (Georgia)	80–82	0.3	22	3–5
Water Washed Filler "A"	80.9	0.4	28	5
Water Washed Filler "B"	80.6	0.3	22	4

Note: Samples A and B were obtained from mills using these grades regularly, and are believed to be representative.



Air-flotation process takes place in a Raymond pulverizing mill with whizzer separator.



Effect of clay fineness on covering power (brightness vs. coat weight).

DECREASE IN PARTICLE SIZE IMPROVES COVERING POWER OF COATING GRADE CLAYS. The fineness of a coating clay, as measured by the percentage of particles finer than two microns in diameter, affects the surface quality of the finished sheet. An increase in the amount of clay finer than two microns manifests itself in the production of paper surfaces with improved brightness, covering power and gloss. Currently produced coating clays range in particle fineness from those in which 70 per cent of the clay consists of particles finer than two microns, to those which are more than 90 per cent finer than two microns. Clays of the Special Hydratex and Hydratex types are the most commonly used for coating purposes.

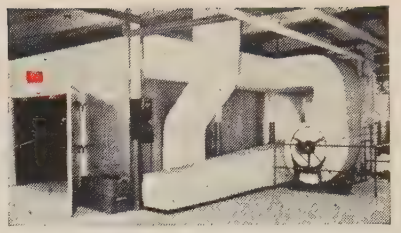
Have you received your copy of "Kaolin Clays and Their Industrial Uses"—new Huber 144-page technical reference book? Write on your company letterhead.

HUBER

J. M. HUBER CORPORATION, *342 Madison Avenue, New York 17, N. Y.*

MINES & PLANTS—LANGLEY, S.C., GRANITEVILLE, S.C., AND HUBER, GA.

ONE OF THE WORLD'S LARGEST CLAY PRODUCERS



The Industry's Symbol Of The
FINEST IN AIR HANDLING EQUIPMENT...

On all classes of industrial equipment are certain makers' names that are universally associated with the ultimate in character and quality of product. On Air Handling Systems—for heating, cooling, controling and conditioning air —that name is ROSS. The new ROSS name plate (pictured below) on a piece of plant equipment will identify that plant as one where the most modern and efficient methods are being utilized to insure the finest quality of finished product. It is the symbol of an accurately engineered, carefully constructed piece of apparatus designed to completely fulfill the ROSS high standard of performance.

ROSS SYSTEMS

J. O. ROSS ENGINEERING
CORPORATION
MANUFACTURERS OF AIR PROCESSING SYSTEMS
350 MADISON AVENUE NEW YORK 17, N. Y.

201 N. Wells Street, CHICAGO-6 • 79 Milk Street, BOSTON-9 • 9225 Grand River Avenue, DETROIT-4 • 600 St. Paul Avenue, LOS ANGELES-14
ROSS ENGINEERING OF CANADA, LIMITED, MONTREAL, CANADA • CARRIER-ROSS ENGINEERING COMPANY, LIMITED, LONDON, ENGLAND

An Unscientific Way to Scientific Help in Packaging

C. S. MACNAIR

It is an almost universal custom to determine your need for a dentist by tasting something sweet. It is unscientific but practical. There is a way to test packaging just as unscientific but certainly very practical.

This discussion can start best with the writer's own definition of the function of a package.

"A package is a protective device used to get an article of commerce from the end of the assembly line, upon which it was fabricated, through an ordinary path of distribution to the customer in exactly the condition that the product was in when it left that assembly line." This calls for another definition. The definition of the "path of distribution" is not so simple. It is the course that a package takes through warehousing, shipping, branch warehousing, wholesaler handling and warehousing, and retailer handling up to the point where a final sale is made to a consumer. It comprises all the hazards that the package encounteres in that trip.

While this "path of distribution" may be marred by occasional accidents, it is not the custom of the transportation agencies or the handlers to have accidents. The whole process is pretty well disciplined. The main job of packaging is not to protect the article of commerce against the unusual accident that it might have but to protect it against the ordinary hazards likely to be encountered in a trip along that "path of distribution."

Even if we totally disregard the accidents which are the unusual causes of package damage there are still an appalling number of claims for damaged merchandise.

However, if the loss and damage claims of The Association of American Railroads and The American Trucking Association were to be compared to your own figures you would probably get a very unreliable and inaccurate barometer to measure with. This must be true, because you just don't have any records of loss and damage in your files. Loss and damage must come to the other fellow, not to you. You forget that claims for loss and damage go to the carrier and not to you.

Your package is just as good as your competitors, and your merchandise is just as good as your competitors. To be better than that would be likely to price you out of the market. If you believe this I'd like to ask you to take a survey of your own sales records to find how many times the sales manager has received a report reading: "The other fellow got the order."

Of these reports how many times did the other fellow get the order just because the dealer who is normally loyal to you just got "fed up" receiving packages that looked shoddy and shop worn before they were ever put on the shelf; that there was too large a proportion of packaged goods that had to be put on the bargain counter because they just didn't look as nice as the competitors.

Consumers will not accept damaged merchandise. If you think this isn't true keep your eyes on a dented can of peas for an hour, in a self-service store, on a crowded Saturday night. Walk over after each customer has made her selection and move the can so that it is the first one to be offered. If you try this, and almost any grocery store manager in the business will lend his cooperation for such a simple test, you will learn a lesson in packaging which you will never forget.

One of the hardest jobs I know is to convince a man that his merchandise, as it is packaged, could have anything conceivably wrong with it. He will even take you out to the end of the production line, as I have been so guided, and he will defy you to see anything wrong with his package. A package that you have already determined by patient study of facts and details to be one of the worst offenders in an industry.

I have had this put up to me by manufacturers of furniture, automotive parts, canned foods, chemicals, electrical parts, and general food products.

It is particularly true in industries where competition is keen because unions pretty well control the unit cost of the commodity by controlling labor output and where the competitive edge has been maintained by a battle to present the public with the cheapest package that looks like it would hold merchandise.

Let's see what can happen to a package. First, assume we have an average factory assembling an average product, I don't much care what the product is just so that it is put into some form of package. Let's assume the package weighs 35 pounds, that's a good average figure. The shipping case is 10 by 15 by 10, that's average too. We'll assume it is all packed up in 200-test corrugated because that would be "rule 41" specification. The product is in a glass container and consists of a capsuled pharmaceutical. The glass jars are machine filled with the capsules and the capsules are held in place with cotton wadding. The entire bottle is filled with carbon dioxide gas to replace the air. It is capped with a continuous thread screw cap designed to make a gas-tight seal when properly applied with a capping machine. The bottle has been wrapped with an advertising folder for additional protection and inserted into a tuck-end top and bottom carton (still average). To comply with Consolidated Freight classification the carton is made of 16-point material. Six of these packages are packed into a counter display carton of a standard type with a cut-out fold-back cover. Eight of these display cases are packed in a shipping case making a standard shipping case of 48 individual sales units.

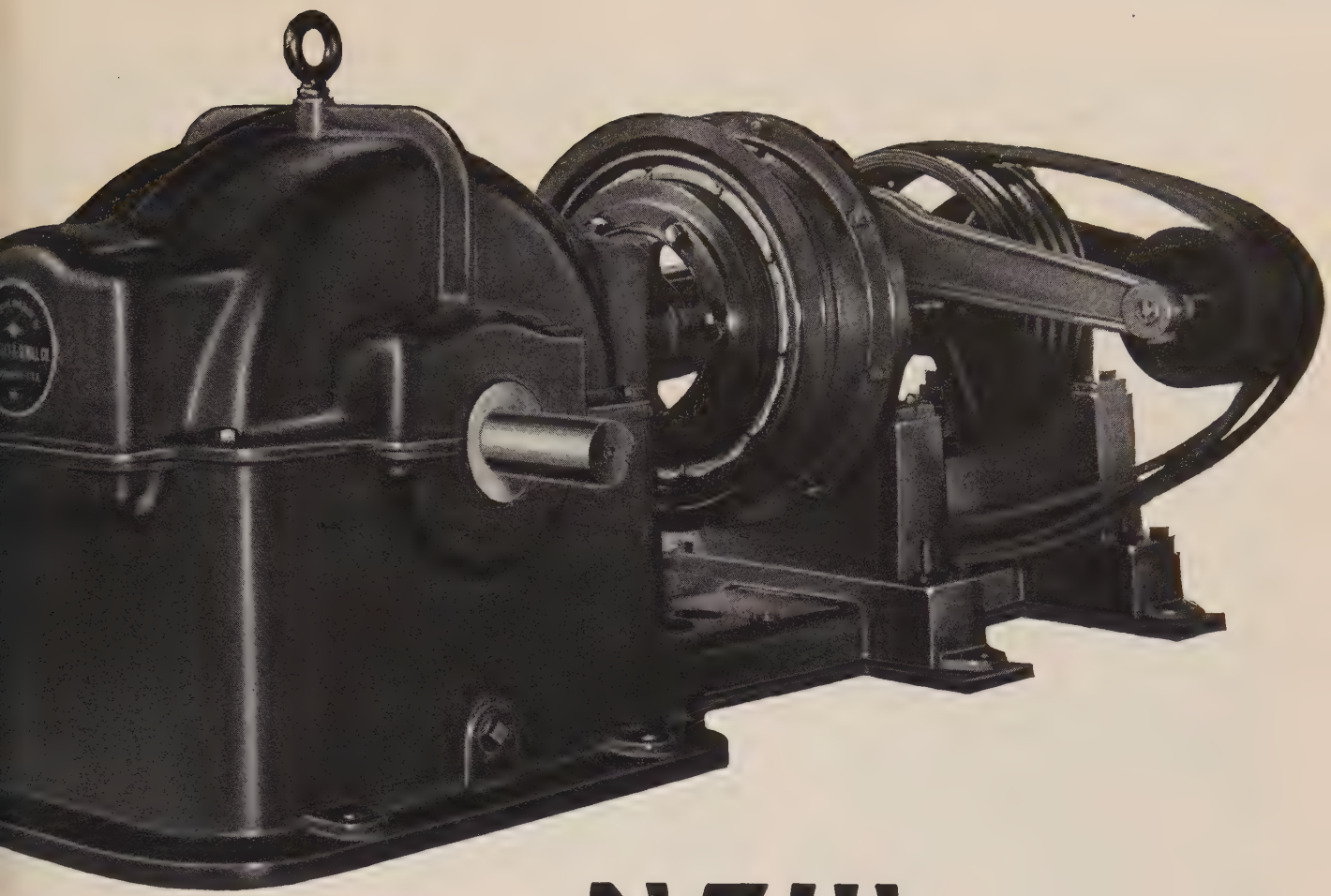
It's so average there are literally thousands just like it. The individual sales unit could be a package of cigarettes, a package of carpet tacks, or the items we have described without making a great deal of difference in the shipping unit or the method of preparation.

The corrugated shipping container has just completed its final assembly operation of being pushed through a top and bottom sealer to seal the top and bottom flaps. With the completion of this operation the shipping unit is ready for distribution. At the end of the top and bottom sealing operation there is a short length of conveyor and the packages are shoved out on this. A package jockey is taking these off the conveyor and with some dexterity is dropping them onto a three-wheeled hand truck.

It is 24 inches from the top of the conveyor line down to the floor of the hand truck.

How many pounds of shock do you estimate this 35-pound package gets at this point? It makes no difference whether it is being dropped off the end of the conveyor or the package

C. S. Macnair, Consultant on Product Development, Acme Steel Co., Chicago, Ill.



It's NEW...

THE BAGLEY AND SEWALL SHORT CENTER DRIVE

Here's a new Bagley and Sewall Drive — definitely new. It's a V-belt, short center Drive that enables you to have the line shaft on the machine room floor — not underneath . . . with a lot of pulleys and flat belts.

Being a V-belt Drive, it's a steadier, more positive Drive — gives you a smooth running machine. Equipped with hypoid gears, it delivers a maximum of power.

This Drive also has a new design in bearing suspension that makes adjustment of the bearings and gears easy. And a gear oil pump gives you positive lubrication of the gears and bearings. This is definitely a new Drive, resulting from eighty years' experience in the manufacture of paper mill machinery.

Write us. Our sales engineers will gladly show you the advantages of this new Drive as applied to your machines.

BAGLEY & SEWALL

DESIGNERS AND BUILDERS OF PAPER MAKING MACHINERY

Representative: Castle and Overton, Inc.
630 Fifth Avenue, Rockefeller Center
New York, New York

WATERTOWN, NEW YORK

Finland Representative: Aktiebolaget Ekstroms Maskinaffar
Helsingfors, Finland

jockey sets it in place with a controlled drop, its still 70 foot pounds. The glue on the package had just begun to "tack" as it came out of the top and bottom sealer in perfect alignment. Each corner was 90° and while there was a strong suction caused by the wet glue sufficient to hold it together it is by no means cemented nor will the glue finish its cementing function for another 25 or 30 minutes.

After the package jockey has dropped this in place how is the glue on the outside flaps? Was there any give? Is the package distorted? It can be, it's easy to check because if the flaps don't meet exactly in the center and their outside edges do not line up in a straight line, the whole package might be distorted. Three degrees will take off approximately 10% of the carton strength.

The first stop this package makes is the "temporary storage" on the assembly floor where it is stacked up waiting for counting, billing, weighing, and general inventory. At the "temporary storage" the package is unloaded and handled again. It may be at the top of the stack or the bottom of the stack. If it is at the top of the stack it might have been handled up there or thrown up. Let's be charitable and say that each package received a 1 foot drop there. For the purposes of this discussion let's consider the package at the bottom of the stack. As a rule it is distorted due to that first jolt and it will get more distortion because they are going to pack these cases 10 high. That means that on a bottom case they are going to put 315 pounds of compression strength against a distorted case not quite dry. So as these cases build up, one on top of the other, each one of them is going to give the bottom case a little jolt and it is going to give with each blow it receives. In other words this case is going to have a load in motion on top of it, because with each jolt it distorts a little more. Let's say the load gave a quarter of an inch. That's applying a dynamic load of about 20 foot pounds of pressure, plus 9 jolts averaging about 35 foot pounds of force.

When the orders are all in it is time to take it from the temporary storage stack to begin carload operations. Again it is picked up off the floor, if it is on the bottom, and placed with that same dexterity which can result in a 2 foot drop onto the hand truck. From there it is wheeled out to the car and again it takes at least a 2 foot drop in any hand loading operations.

You don't believe these figures are average? I believe the Analysis Recorder Company or the Redhead people could show a number of convincing tape recordings that they have taken with their shock recording equipment proving that this kind of shock has been very conservatively figured in this discussion.

This can give you a total force of 555 foot pounds applied to your package before it even leaves your plant. At the other end of the line this is going to be repeated.

You have delivered to your package, forces equal to several hundred pounds of effort measured in foot pounds before the consumer get his hands on it, before it is ever offered to him for sale. Have you realized before just what a beating your merchandise takes in your own plant?

Now then the question comes up: should you wait until the package has had a lot of complaints against it? The common practice is to wait until you get a lot of complaints, lose a lot of business, possibly suffer irreparable injury in a particular buyer's market that you were trying to hold and then try your best to lock the door after the horse has been stolen. There are people who have been known to wait until damage claims become so high on their merchandise that the transportation agencies will not accept them.

Another way to do it would be to turn all your packages over to a specialist with a testing laboratory. That is expensive, particularly if you are bound, within an industry, by traditional methods of packaging that seem to have been satisfactory for a good many years.

There is a way that you can be sure! A cheap inexpensive way. You can test a package yourself to see whether you need help on it! It is just as practical and holds as much "down to earth common sense as the time honored method of rolling something very sweet around on the end of your tongue to check to see whether it would be a good time to make a trip to the dentist.

Packages can be checked to determine whether you need some kind of revision. My favorite device for testing, in this phase, is a staircase. Any old steps will do, and it doesn't make a great deal of difference where these steps are located just so they're convenient, nor what they're made of; wood, concrete, steel. However, you must use the same steps consistently. Here is what I would do if I were going to make a test of this type. Take a carton directly off the end of the top and bottom sealer allowing no elapsed time so that your test gives complete details. Number every face, starting with the front of the package: No. 1 straight around the package face 2, face 3, and face 4. The ends are Nos. 5 and 6. Pick out a convenient set of steps. Set this package on the third step with face No. 1 out, move it out over the ledge of the steps until it overbalances itself and falls to the floor. It will fall from the third step across the second step and the first step to the level. Pick it up and repeat the experiment on each face of the carton.

Let's see what results we get. There is really no damage that doesn't approximate the forces that have been applied against this package between the end of the asembly line and your carloading operations. When you get through you have applied a total force of about 350 foot pounds on this 35-pound package.

Although I will admit that forces are applied in a concentrated manner this is less force than has been applied in the normal course of handling in the plant before shipping. It will take you less than five minutes to perform this type of test on a case.

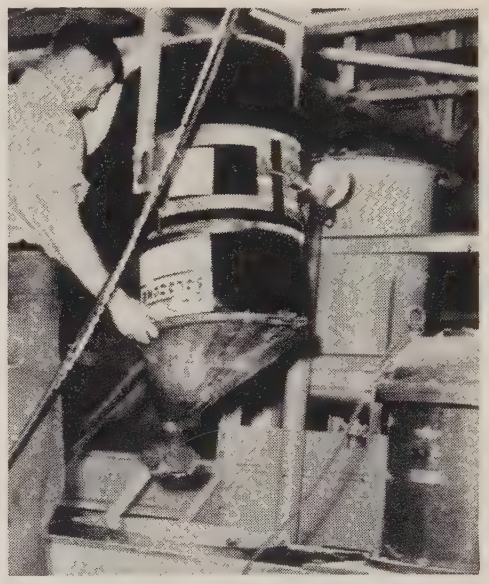
Open the case after the test! In the first place we see that the shipping case has a couple of battered corners, not bad but battered. One of the corrugated liners had been torn. The whole case is twisted so that the glue is now holding the flaps at a slightly different angle than when we started. We had a certain amount of torque in the shipping case. As we open it we will find that torque has been applied to the display cartons inside. The first one we pull out has had the display cut out ripped across the score line by becoming engaged with the lock bottom of the adjacent display case. The display carton in the corner under the damaged place in the shipping case has been poked clear through and has been damaged beyond use. Let's open this. There are two pieces of merchandise that also have been damged, they are the ones that fit adjacent to this corner and have been stove in. Here are two out of eight counter displays that can't be displayed on counters. A druggist can't display them, that's for sure, but he can put the individual sales units on a shelf, except that they look like old merchandise, not hurt, but shop worn. Take them out of the display and open the sales unit. Here is one with a loose cap on the bottle. It received the full force of the shock. You can twist the cap with your fingers. You couldn't twist it when it left the end of the production line, it was on gas tight. Rancidity of the capsules themselves is possible. Here is destroyed merchandise. You don't have to have broken glass.

If all the material were taken out of the case a high percentage of it would be found damaged—some not fit to show on a dealer's counter. A question of possible contamination might arise in the consumer's mind. Some units would be actually defective to the point of uselessness. The test is yours to judge! If your package test is similar to this you need help and help should come from one of the best package men that you can call in consultation.

Presented at the Annual Meeting of the Technical Association of the Pulp & Paper Industry New York, N. Y., Feb. 20–23, 1950.

Bucksport, Maine mill, Maine Seaboard Division, St. Regis Paper Co.

Since 1941 . . . St. Regis has economically produced more and better paper with the DU PONT PEROXIDE PROCESS FOR GROUNDWOOD BLEACHING



During the past 10 years, the St. Regis Paper Company, one of the pioneers in pulp bleaching with peroxide, has met with outstanding success in groundwood bleaching.

One of the most recent additions to this record of achievement is the mill at Bucksport, Maine, where St. Regis was the first to bleach a high-consistency mixture of groundwood and sulfite in continuous operation. In this modern mill, streamlined for straight-line flow from wood room to shipping platform, the peroxide bleaching process has fit in smoothly with the continuous production of paper . . . more and better paper.

High on the list of advantages of peroxide bleaching noted at the Bucksport Mill is the remarkable improvement in paper brightness when a substantial percentage of bleached groundwood is included in the paper finish.

Experience has shown that peroxide bleaching is not limited to groundwood. It can be adapted to soda, sulfite, semi-chemical, and kraft pulps and for waste-paper recovery. Technical service and assistance in specific applications are available upon request. For more information about Du Pont peroxides and Du Pont bleaching process, just fill in and mail the coupon below.

Tune in to Du Pont "CAVALCADE OF AMERICA" *Tuesday Nights—NBC coast to coast*

DU PONT
PEROXIDES
FOR GROUNDWOOD BLEACHING

AVAILABLE IN DRUMS AND TANK CARS
- **"Albone" 35 . . . . . Hydrogen Peroxide, 35%**
- **"Albone" 50 . . . . . Hydrogen Peroxide, 50%**
- **"Solozone" . . . . . Sodium Peroxide**

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

Mail this coupon now

E. I. du Pont de Nemours & Co. (Inc.)
Electrochemicals Dept., Wilmington 98, Delaware

Please send me further information about Du Pont peroxide bleaching processes: (check application)

____Groundwood ____Sulfite ____Soda Pulp ____Kraft

____Semi-chemical pulps ____Waste-paper recovery

*Name*_____

*Position*_____

*Firm*_____

*Address*_____

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

Westinghouse Drives

FOR PAPER FINISHING AND CONVERTING MACHINERY

Westinghouse

EQUIPMENT FOR THE PAPER INDUSTRY

HERE'S HELP...

in selecting the right drive for your finishing and converting machinery

Here's a new booklet to help you select the right drive for your paper finishing and converting machinery. It shows how the right drive applied to the equipment you now have in service, as well as future installations, will help you produce consistently uniform paper products—faster and at lower cost.

Drive requirements differ as much as the finishing and converting machines themselves. Some can use packaged drives. Others need tailor-made equipment. Required operating ranges and degrees of speed control are different. This booklet helps you select the one best drive that will get the most out of your equipment.

For your copy of this useful booklet, just fill out the coupon below. Naturally, our Paper Industry Specialists are readily available for further assistance. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-94799

SOME WESTINGHOUSE DRIVES FOR FINISHING & CONVERTING:

AV Life-Line Packaged Drive

Modern Westinghouse Supercalender Drive

MOT-O-TROL, the all-electronic packaged drive

Westinghouse Winder Drives

Co-ordinated drives for individual coater and corrugating machine sections

HOW WESTINGHOUSE DRIVES IMPROVE PERFORMANCE

Here are some of the advantages that modern Westinghouse electric drives bring to finishing and converting mill operations:

Higher operating efficiency from centralized control of all machine operations with adequate metering. Breakage and outage time for rethreading are reduced.

Lower operating costs from co ordinated electric drives. Eliminating mechanical devices saves power, reduces maintenance.

Westinghouse Electric Corp., Dept. TB-5,
P. O. Box 868, Pittsburgh 30, Pa.

Gentlemen:
Please send at no charge my copy of "Westinghouse Drives for Paper Finishing and Converting."

Name_____

Title_____

Company_____

Street_____

City_____ State_____

Some Aspects of Container Handling in Rail Transportation

EDWARD J. DAHILL

THE ART and science of the manufacture and use of shipping containers and of materials handling was given much impetus during the last war, and fortunately, that impetus is being carried over into peace time operations for both domestic and foreign shipments. Daily there are immense quantities of products packed in containers of many types moving from innumerable shipping points to many receiving points. These products are not always arriving in as good condition as they should and one of the purposes of this discussion is to encourage thinking on some aspects of the problem of eliminating loss and damage, and to present some factual data that may be of help.

Now it just isn't practicable to ship all products of our plants and farms without some kind of container which serves the purpose of protection against heat, cold, moisture, overhead weights, pressures and impacts; against sifting, vermin, insects, and pilferage. The container gives the goods unity, provides a place for the name and address of the shipper and receiver, permits the addition of safety and handling directions, helps in keeping inventories, and most important, provides a means of handling and warehousing the goods.

Each article or product has different properties which must be considered in deciding upon:

1. How many articles will be packed to make up the shipping unit.
2. What factors must be taken into account in selecting the container.
3. What elements must the articles be protected against.
4. How the shipping unit is to be handled.
5. What will be the costs, not just the immediate costs, but the over-all costs.

As you are primarily interested in paper and paper products, this discussion of containers will be directed toward those made of paper and paper fiber.

Over the years, since the introduction of the fiber box and paper shipping bags, there has been built up a wealth of experience both in the manufacture and adaptation of containers of these types to many commodities, yet there appears to be something that hasn't quite kept pace with the growth and the changing conditions and demands. This something is an accepted test or tests and procedure which will give an accepted measure of the serviceability which it can be anticipated the containers will furnish.

Now, in 1948 there were produced 22,048,000 tons of paper and paperboards in this country, of which 10,853,000 tons or 49.2% was paperboard, and of this latter tonage 4,969,000 tons, or 45.8% was fiberboard. With such a heavy proportion going into shipping containers, it would be expected that the industry as a whole would be most active in developing and setting up standards of use and serviceability and how to measure these qualities. You have many long accepted standards and methods of tests for your bristols, bonds, ledgers, printing, and fine papers. But do you have anything other than the bursting strength test to measure the end use and serviceability of the containers made of fiberboard and heavy papers?

Your natural reply is, how can we set up such tests unless we know what is demanded of our containers and what are the hazards met with in handling, warehousing, and transportation, how numerous are they, their amplitude, frequency, and intensity; and are these hazards natural or man made; what factors of safety should be built into our products; how can we translate into measurable terms or quanitities these hazards and handlings; and then how can we simulate them by use of testing instruments and procedures which will put us in the position of being able to guarantee or assure the users of our products that our containers will consistently, with proper use and reasonable handling, deliver their contents in safe and satisfactory condition.

Starting about October, 1907, there was published for the first time in a railroad Tariff, a requirement for a burst test for fiber boxes. In 1919 the Consolidated Freight Classification was first issued and therein was included the famous Rule 41. This rule was largely written by representatives of the fiber industry and accepted by the railroads and the many changes and additions to this rule have come about through proposals from the fiber box industry, the shippers, and the railroads. Of course, there were other requirements for boxes and bags such as caliper, weight and size limitations but the burst test was the only strength test and it really could not be called a serviceability test. Nevertheless, it has persisted in the Rule ever since but has been battered about from pillar to post, praised and condemned. I will not here go into the merits and demerits of the various arguments concerning this test but it is interesting to note that only a few years ago, when the Classification Committee held a series of special hearings throughout the country for the purpose of receiving information and suggestions on the subject of the burst test, those who most strenuously objected to the test had no substitute to offer.

It seems there is general agreement that the burst test gives some measure of the worth of the materials going to make up the box or bag but there is no agreement that it is a test of the finished container, for it gives no indication of the strength of the manufacturer's joint, how well or poorly the container is scored and most important, how the container is closed, for it is this last operation which often proves whether the container will or will not serve its purpose properly.

So let us turn, for the moment, to that phase of this discussion bearing on what the container is going to meet with in a typical journey.

I jotted down a list showing the minimum number of times that a container would be handled in a typical carload and L.C.L. shipment by rail.

When I use the term "handle," I mean the operation of picking up and putting down the package manually. Counting these handlings in a carload shipment of canned goods, beer, or groceries, for example, from the manufacturer to the retailer, the minimum number comes to 16, which includes the movement from a warehouse by an auto truck to a retailer's store.

In an L.C.L. shipment, including one rail transfer enroute, the handlings counted up to a minimum of 24. With two transfers, the number increases to 27. In connection with this subject, I am told by the Railroad Express Agency that there is a minimum number of 16 handlings of a package moving by Air Express.

In a carload shipment, the goods are not touched by railroad forces as they are loaded by the shipper, unloaded by the receiver, and the railroad simply moves the loaded car. In an L.C.L. shipment, on the other hand, the rail forces may pick up and deliver the packages as well as handling them through the stations and transfers, and into and out of the cars.

What this, in effect, amounts to, is that there is much of the human element in the transportation and distribution of goods, and it is our observation that much of the damage happens during this manual handling.

Now, what happens inside of a railroad car after the goods have been loaded therein? In most carload shipments, the containers are of the same or similar character and size and they can be loaded in an orderly even manner like bricks in a wall, filling the entire floor space and leaving no slack in the load. In such a load the boxes mutually support each other and generally present flat smooth surfaces to withstand over-

EDWARD J. DAHILL, Chief Engineer, Freight Loading and Container Section, Association of American Railroads, Chicago, Ill.

"Nam non solum scire aliquid artis est, sed quaedam ars etiam docendi"

(Cicero: De Legibus)

"Not only is there an art in knowing a thing, but also a certain art in teaching it"

The unerring hand of the journeyman weaver deftly guides each tiny thread of wire into its rightful place while "dressing" the loom—a task so painstaking that it may be two weeks before a giant loom is ready to weave. The infinite skill and patience necessary to this job are also required for the fine art of passing the technique on to others. Our Apprentice Training Program is your assurance that we can say tomorrow, as we do today, that Eastwood Wires are as good as human skill and mechanical genius can make them.

EASTWOOD WIRES made from CENTRIFUGALLY CAST ALLOYS

EASTWOOD · NEALLEY Corporation

BELLEVILLE, NEW JERSEY

SERVING THE PAPER INDUSTRY SINCE 1877

head pressures and longitudinal and lateral forces. In an L.C.L. car, on the other hand, the load in any one car may run from a grand piano in a wooden box, to large bulky fiber boxes of breakfast foods, to bare iron bars, bags of cement, steel drums of oil, and reels of cable. To fit all of these together into a car so that each will be protected from its neighbors requires skill and knowledge. No two cars will be alike. The loader doesn't know what is coming to him and especially toward the close of the day, when it is necessary to get the car rolling, it takes a good man to put up a load that will carry through safely without any shifting or damage. It should be kept in mind that very frequently a shipment that starts out as a carload will eventually land up as L.C.L. shipments.

A freight car in transit has three motions, laterally across the car, vertically, and longitudinally. A package may be subjected to one of these motions only or it may be subjected to two at the same time.

A freight car is not a warehouse, it is, in effect, a large packing box on wheels and the same principles that should govern in packing a small shipping container should be used in stowing and bracing a load within a freight car. From the very nature of rail transportation and all motion, there are bound to be hazards against which articles should be so prepared and so packed and containers used, that they can withstand these normal hazards. There are normal hazards in any motion, as indicated by the tremendous bumpers that are put fore and aft on our automobiles and the continued study being made by the automobile manufacturers to develop more efficient brakes to stop the cars during emergencies as well as during ordinary service stops.

Of the three motions I mentioned, those laterally or across the car are of the least intensity. They are caused by a swaying car that may be unevenly loaded or when a car goes around a curve at high speed and the effects of centrifugal force cause pressure laterally on the load. This force, however, is not one of a sudden nature but usually starts small and gradually works up to its highest point and then again gradually reduces. For an ordinary load of goods such as would be packed in fiber boxes, it does not have too much of a damaging effect, but is one that must be carefully guarded against for articles of a top heavy nature which may be loaded in a car, such as a vertical drill press. The second motion of greater intensity is the vertical motion caused by the oscillation of the car due to rail joints, crossings, low spots, and frequently road crossings. This oscillation does not have an amplitude of much over plus or minus an inch, but will go beyond that in some severe cases and its frequency will not run over 240 to 260 a minute. This compares with a frequency of around 2000 a minute in an airplane, but with an amplitude of possibly not over 1/100th of an inch which is not perceptible to the human senses.

The third motion which can be the most severe is lengthwise of the car and occurs when there is a sudden application of the emergency brakes when cars are coupled at excessive speeds or a car runs into a bumper at high speed.

The operating executives of all railroads have standing orders and instructions that cars must not be coupled at speeds exceeding 4 to $4^1/_2$ m.p.h. At these speeds modern draft gears are capable of absorbing most of the kinetic energy and do not transmit the force of the impact to the load. As the speed of coupling increases, the severity of the destructive forces increases not directly, but more in line with the square of the velocity.

A few years ago, one of the railroads recorded some data of a typical 100 mile run of two 40-ton cars, each loaded to a total weight of 135,000 pounds on the rails, at speeds between 40 and 60 m.p.h. They recorded the number of vertical shocks with the cars equipped with ordinary springs and the cars equipped with coil springs and adequate snubbers. As practically all cars today are equipped with snubbers, I shall give you the results of this test having the snubbed springs. They recorded 2462 vertical shocks of 0.25 G.; 49 of 0.50 G.; and none at 0.75 G. or 1.25 G. The total bolster motion downward for the run was 6210 inches and the maximum spring deflection was 0.62 inches.

For the last two years, the Mechanical Division of the Association of American Railroads has been conducting road tests making use of two laboratory cars equipped with the very latest recording apparatus to record the performance of different kinds of railroad car trucks, different assemblies of spring supports and of snubbers, and have developed some very interesting data which have not yet been released. The association with the cooperation of the car manufacturers are constantly searching for a railroad truck that will give as smooth a ride as our modern streamlined passenger cars and I am happy to tell you that they have come a long ways from the trucks used only a few years ago, and have developed a type of truck and spring suspension that has shown wonderful performance. Likewise with draft gears, the manufacturers of these devices and the railroads are continuously seeking to design and develop draft gears of high capacity and cushioning qualities, and part of the evidence of their research is being demonstrated in the fine riding qualities of our latest designed passenger cars.

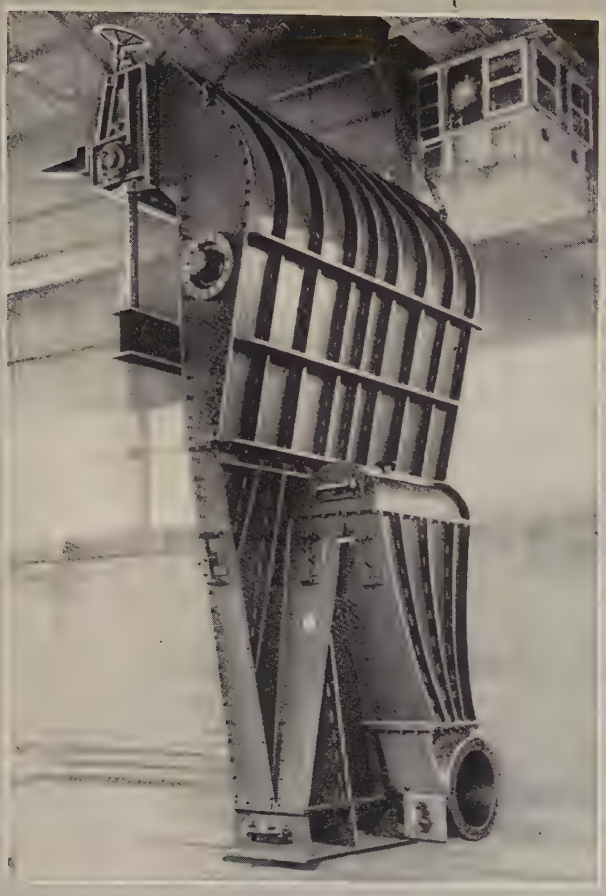
Now, I mentioned the number of times an article would be manually handled. What does this manual handling consist of and what will be its intensity and frequency? I have indicated what the minimum frequency will be in both the carload and L.C.L. shipment; now what would be the intensity of it?

The height of warehouse platforms and freight car floors is approximately 4 feet as is also the tailboard of a truck. When a container falls from this height, the fall is usually accidental and to set up this height as the criterion on which the construction of containers for domestic use should be based, and inside packing developed, is more than should be reasonably expected. A man handling a package up to about 20 pounds is very apt to throw it and the height of his hands when he lets go will be around 2 to $2^1/_2$ feet. This throw, however, is not usually a straight drop but a movement in a sloping direction and when the container hits the floor it is a combination of a slide and a drop. If a man were handling a package weighing approximately 75 pounds, he would be apt to place the container down by dropping the lower corner or edge of the package 3 to 6 inches and then letting the container come to rest by dropping the remainder of it or easing it down so that the drop as a whole can be considered to be about 1 foot.

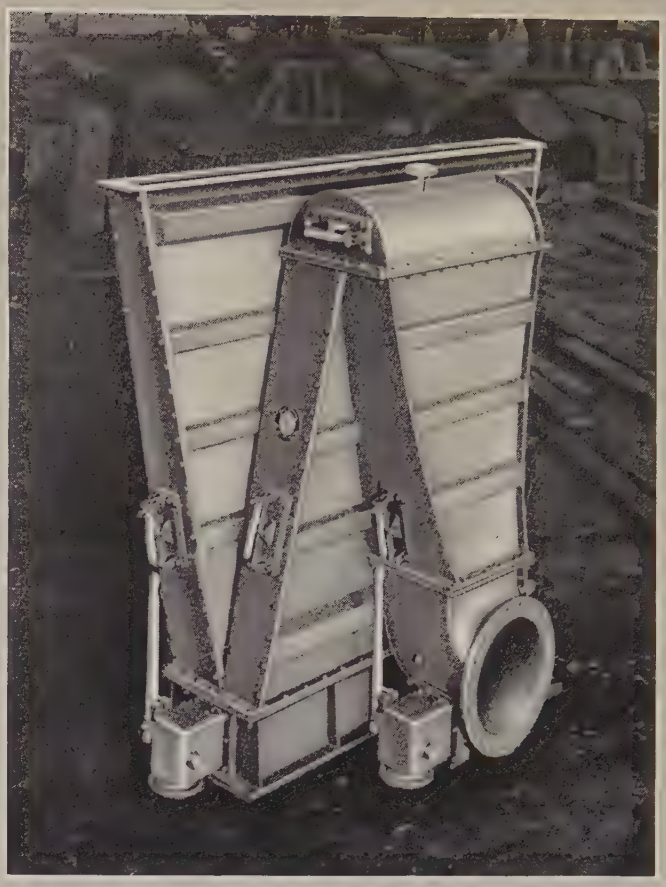
If a container weighed 75 to 200 pounds, it would probably be handled by two men and one of them would be apt to place his end down reasonably gently, then the other man will ease his end partially down and drop it the rest of the way. Thus one end may have a maximum fall of approximately $^1/_2$ foot but for the center of gravity of the article, the drop may be approximately $^1/_4$ foot.

In considering performance tests, one of the subcommittees of A.S.T.M. has tentatively arrived at these criteria: Packages weighing 0 to 50 pounds, one man will throw; 50 to 90 pounds, one man will lift; 90 to 200 pounds, two men lifting; 200 to 500 pounds, manually lifting with equipment; 500 to 1000 pounds, handling with power equipment; 1000 pounds and up, special handling equipment.

Through the courtesy of H. R. Marvin, Industrial Engineering Department, Kodak Park Works, I am able to present to you a study Mr. Marvin made of the handling of his company's packages from the plant to the retail distributor, the flow chart he developed, and the tests evolved from this study. He states that the basic approach in establishing the procedures has been to determine as far as possible, the hazards his products encounter in shipments and then to simulate these hazards in his laboratory. Somewhat significantly, he states that he is continuing to make periodic field studies to



Flow Spreader and Slice Assembly



Improved Type Flow Spreader

Flow Spreader Ends "Wild Sheet" Formation

Proper flow spread is highly important on both Cylinder and Fourdrinier Machines. Water in motion has surging energy and can produce objectionable flow turbulence, resulting in "wild sheets" if it is not accurately controlled.

The Puseyjones Flow Spreader for Cylinder Machines is equipped with a hydraulic nozzle in its new, compact design which "squeezes" the flow by decreasing area and increasing velocity with the result that the approach flow is smooth and even.

The Puseyjones Flow Spreader for Fourdrinier Machines permits the formation of stock of widely different weights, over a wide range of speeds, and gives the best possible formation for each condition.

Find out how a new Puseyjones Flow Spreader can improve your *quality* and production speed. Write today for complete details.

FLOW SPREADER INSTALLATIONS

Flow Spreaders are now being used successfully in these outstanding mills:

Hollingsworth & Whitney Co. Waterville, Me.	4
Hollingsworth & Whitney Co. Mobile, Ala.	4
Union Mills Paper Manufacturing Co., New Hope, Pa.	3
U.S. Gypsum Co., Oakmont, Pa.	1
Crocker-Burbank & Co., Ass'n Fitchburg, Mass.	8
The Flintkote Co., New Orleans, La.	1
New Haven Pulp & Board Co. New Haven, Conn.	3
Eastman Kodak Co., Rochester, N.Y.	2
Kimberly-Clark Corp., Neenah, Wis.	1
St. Mary's Kraft Corp. St. Mary's, Ga.	1
Pioneer Div. The Flintkote Co. Los Angeles, Calif.	1
San Rafael Paper Co., Mexico	2
Groveton Papers Co., Groveton, N.H.	1
Rushmore Paper Mills, Inc. Natural Dam, N.Y.	1
Congoleum-Nairn, Inc. Cedarhurst, Md.	1
Fibreboard Products Inc. E. Antioch, Calif.	1
A. B. Stjernfors Stalldallen, Sweden	3
A. B. Papyrus, Sweden	3
St. Regis Paper Co., Tacoma, Wash.	1
Papierfabrik Utzenstorf, Switzerland	1
The Ohio Boxboard Co., Rittman, O.	3
Calcasieu Paper Co., Elizabeth, La.	1
National Newsprint & Paper Mills, Ltd., India	1
Total	48

THE PUSEY AND JONES CORPORATION

Established 1848. Builders of Paper-Making Machinery

Wilmington 99, Delaware, U.S.A.

THE SIGN OF TRADE MARK SUPERIOR QUALITY

determine whether changing conditions necessitate revising the 11 procedures which he has already set up.

Mr. Marvin has gone much further than I did in just counting the number of handlings and their intensities in an ordinary shipment, for he has equated to each and every movement, whether it be on a roller, conveyor, on a hand truck, down a chute, on a delivery truck, etc., what he considers to be an equivalent drop, impact, or vibration.

On a large chart he lists 42 operations designated by a colored circle, to distinguish between a drop, an impact and a vibration, and on a second chart, there is given a pictorial presentation of each of these actions, with a description as to when and how they occur. Altogether there is a total of 32 drops adding up to 250 inches; seven vibrations, for a total of 28 minutes and; 11 impacts, for a total of 17 feet. This is an excellent study and deserves much consideration. Mr. Marvin tells me that copies of these charts in letter size may be obtained by writing to him.

There has been organized what is known as the National Safe Transit Program of the Porcelain Enamel Institute Committees made up of representatives of manufacturers of the goods, container manufacturers, and transportation agencies. This committee has already set up a testing procedure under Project No. 1, which covers preshipment tests for packages weighing 100 to 1000 pounds, and for Project No. 1-A, for packaged units less than 100 pounds. The tests used are the vibration and impact for the large articles, and vibration and drop for articles under Project No. 1-A. The committee and its various divisions are now working on Projects 3 and 4, which cover loading research, namely methods of stowing, loading, and bracing the packaged articles in freight cars. It is significant that in all cases the tests are all on the completed article ready for shipment and not on the individual parts going to make up the interior packing and the shipping container itself. A complete brochure on these tests will be available soon for distribution, I understand, and I would recommend it to your attention for study and for possible adoption by other industries.

If these are the conditions that are going to be met with under usual transportation, what kind of testing device or procedure could be set up that would simulate them, which would be reproducible and could be measured in definite units? We have come to the conclusion that there is no one single test that will meet all conditions and measure all the various quantities and qualities that are desired.

For a number of years, the revolving drum test was considered to be a very good test, and it is for the retention of contents, but the test is hardly similar to actual handling and shipping conditions and the apparatus is large, heavy, and not readily available to even the biggest shippers.

Giving thought to this matter, the former Freight Container Bureau developed what has been called, the Conbur Incline Impact Tester. The idea behind this test is, first, that most damage comes because a package is dropped or receives an impact. Therefore, we endeavored to find some simple way to simulate this impact and to be able to reproduce the test exactly. The ordinary drop test is used very extensively but usually there is a supplemental impact or fall after the initial drop which you cannot always reproduce and the action occurs so quickly that the eye cannot follow what happens. The incline impact test is a drop test, in effect, slowed down to where the act can be watched with the eye and if desired slow-motion pictures may be taken of the impact for later study. It simulates the action of a box being thrown down a slide into a cellar, or the shift of a load in a car, and permits the testing of large size articles such as stoves, radios, iceboxes, and large pieces of furniture already packed, as they would be shipped. It is a test of the finished container, the inside blocking, packing, and cushioning, and rather interestingly, those who have constructed and used this device are finding that it is also a test of the design and construction of their articles that they manufacture.

In the last few years, much attention has been given to developing a vibrator which will simulate the vertical accelerations and decelerations of a freight car or a truck and there are several machines now on the market. They are particularly useful in connection with delicate instruments, those which may have many bolts, nuts, and soldered joints to determine whether these parts will be held tightly together while in transit, and to help in determining the dampening qualities of the various cushioning materials that are on the market.

I have not mentioned anything about humidity particularly, although I did mention the natural elements that must be guarded against in many cases. Most laboratory tests today are being made under 50% relative humidity but we know that in a car of citrus fruit, for instance, from California to New York, there will be an average relative humidity of 85% for the entire journey, and going as high as 95% at different times. Bagged potatoes from Maine taken out of 36° storage and loaded into heated cars will develop a relative humidity up to the dew point for a number of days, and the reverse of this situation is where flour and some manufactured articles are packed hot in paper bags, loaded in cars at low temperatures, and much sweating occurs. These situations raise the question as to what the terms "Waterproof" and "Waterproofed" really mean and what is a paper designated as "wet strength" going to stand and how much of its strength will it lose under the humid conditions with which it meets.

The temperature in a box car, in the hot desert areas of the West will go as high as 135°. A relative humidity of 100% will occur in refrigerator cars containing fruits and vegetables and we have had some instances of carloads of furniture crates with green lumber in which the humidity was high enough to cause a separation of veneers.

Now there appears to be a trend toward performance tests; that is, that the completely packed container must withstand certain pressures, or drops or periods of times on a vibrator. There are in the Consolidated Classification today, a few tests which are of the performance variety in which it is specified that the containers shall have a compression strength of a definite amount.

I have been in manufacturing plants putting up juices and soups in cans, where the packed boxes have been piled 30 and 50 layers high. No reasonable man would expect that boxes must be furnished to withstand such tremendous weights and we know, of course, that the cans were carrying the weight and not the boxes. This brings us to a point, which has been discussed in fiberboard circles, of what is called "fatigue." It does not seem that this fatigue is quite the same as that of the fatigue of metals, for the two materials, fiberboard and metals, are of a distinctly different character and while the term "fatigue" may be a good one to describe what happens, it does seem that a more comprehensive term could be used.

In connection with this subject, I noticed an item in a trade journal not so long ago quoting from some tests made by a commercial laboratory using fiber boxes which had a compression test, top to bottom, of 509 pounds average and 460 pounds minimum. When these boxes were piled three high empty, under a static weight of 382 pounds, 75% of the average compressive strength, they collapsed in less than an hour; yet when the same boxes were piled three high, under a weight of 255 pounds, 50% of the average compressive strength, the pile stayed up straight for over 8 days.

Now, I have not attempted to say what the solution of this problem is, although I have endeavored to try to emphasize that the end use of the container, the handling to which it is subjected, and what might be called the serviceability, are subjects that definitely should interest this audience. I have furnished you some fragmentary information and cited a few examples which may start you thinking about what the solutions might be, and I feel that I have accomplished my objective if I have started you thinking.

Presented at the Annual Meeting of the Technical Association of the Pulp & Paper Industry, New York, N. Y., Feb. 20–23, 1950.

HERMANN *Improved* CLAFLIN

INSTALLATION

PORT HURON SULPHITE & PAPER COMPANY

"NEW PULP TREATING DEPARTMENT"

No. 2 HERMANN CLAFIN REFINER DIRECT CONNECTED TO A 200 H. P. MOTOR 360 RPM. PULPED SULPHITE STOCK IS PUMPED TO THE CLAFLIN FROM STOCK CHEST. VALVES CONTROL VOLUME TO CLAFLIN WITH OVERFLOW BACK TO CHEST. STOCK PASSES JUST ONCE THROUGH THE CLAFLIN TO STORAGE CHEST TO BLEACHING. CLAFIN IS PRODUCING EXCELLENT RESULTS ON 75 TONS PER DAY WITHOUT CROWDING AND WITH 150 H. P.

A No. 1 CLAFLIN (OLD) IS TO BE PUT IN SERVICE FOR THE SAME PURPOSE AND COMPARABLE ARRANGEMENT FOR KRAFT PULP.

"Most Versatile Refiner in the Field For Stock Preparation"

THE HERMANN MANUFACTURING CO.

Also Mfg's of TAPPI Standard Pulp Testing-Sheet Making Apparatus

LANCASTER, OHIO

Quality Control of Corrugated Shipping Cases from a Buyer's Viewpoint

E. H. BALKEMA

I APPRECIATE the opportunity of appearing before you today to discuss the subject of quality control of corrugated shipping cases. This is rapidly becoming a most complicated subject. Therefore, we will only be able to discuss some of the more important phases as we see them from our viewpoint. Our viewpoint of course, is of necessity, limited to our requirements and problems but I hope that this discussion will leave with you a desire to study your problems with an open mind and without any preconceived ideas. To help you to do this, it is my desire to give you some of the methods which we use to measure the ability of our corrugated cases to do their assigned jobs.

During the past 20 years the amount of board used in corrugated cases has doubled and this trend can be expected to continue. Typical examples of developments are 9-point mediums which are laminated or impregnated. It is believed that this approach will greatly increase the rigidity of the corrugating medium and thus permit new applications not heretofore deemed advisable, especially where high humidities are encountered.

Expendable pallets and corrugated cases for nuts and bolts to replace kegs might also be considered as examples of the extended use of corrugated board.

Canned fruits, vegetables, and orange juice are being packed in ever-increasing quantities.

It is also interesting to note that the shipments of corrugated material during the last week of September, 1949, reached an all-time high. Although the production during the first half of 1949 was about 9% less than during a like period of 1948, it is expected that the total production for 1949 will only be approximately 4% less than the previous year, and will only be exceeded in total production by 1947 and 1948.

Many times I have been asked "Why do you test corrugated shipping cases?" The answer is somewhat more complicated than the question.

At the present time there are between 300 and 400 companies manufacturing corrugated shipping cases in this country. In my opinion, less than 50% have adequate established controls which will permit them to manufacture corrugated shipping cases which will meet our specified requirements.

In some large companies, that have their own testing laboratories and who employ the services of commercial testing laboratories, there is a wide variation in the quality. This variation exists from plant to plant, day to day, shift to shift, and even within the same shift. Many of the smaller companies do not employ the services of commercial testing laboratories or have their own. Therefore, there is no record of the quality of the cases which they produce unless the tests are made by the purchasers.

With this known variation in quality, we are required to test corrugated shipping cases in order to enforce the test requirements shown on our written specifications.

SAMPLING METHOD

It is important that the method used in obtaining samples from a shipment is such that the tests will properly reflect the quality of that shipment. We believe that the required number of samples should be selected by a person who is not familiar with either the use or the testing procedure, that each sample should be taken from the center of a bundle and only one sample from each bundle. In this manner we believe we secure a fair cross section of the delivery which will be representative of the entire delivery.

For a complete test from a new source of supply or from a present source of supply that has run into trouble in meeting our written specifications, we generally require 12 samples for the test. We sometimes also use a commercial testing laboratory to check our results and when this procedure is followed we take two samples from each selected bundle and make up two sets of test samples. One of these sets is sent to the commercial testing laboratory and the other set is tested by our own laboratory.

For routine acceptance tests we select five samples and if they prove to be satisfactory the delivery is approved for use. However, if this small lot does not pass the specifications, then the delivery is resampled and a complete test is made.

TESTING

All tests should be conducted under standard test conditions by a properly trained operator who can adequately interpret and report the results.

There are many tests which can be used such as a burst test, a drum test, an inclined impact test, a puncture test, a drop test, a vibration test, a compression test, or some other test. This information is available to you through your suppliers, commercial testing laboratories, or through trade magazines, technical associations, and publications.

We prefer to divide these tests into two classifications. First are those over which our sources of supply have a definite control such as the burst and compression tests. The second classification would be those tests primarily controlled by the user of the corrugated cases and which depend to a considerable extent on the internal packaging. Typical examples are the drop test and the inclined impact test.

We are primarily interested in purchasing good quality corrugated cases and, therefore, we must tell our suppliers what we want through written specifications and then we must insist that they deliver in line with those specifications. In order to be fair in this requirement, it is our belief that we must not confuse what we expect from our suppliers with what we expect of the corrugated shipping case after we have it packed for shipment. A good corrugated case can be ruined by improper handling, inadequate internal packing or improper storage conditions, all of which cannot be controlled by the maker of the corrugated cases.

Therefore, in our written specifications which go to our suppliers, we only specify those tests which can be made on an empty case and shipments are either accepted or rejected on the basis of those tests.

Of course, we have other tests which we apply to the packed shipping case, but we consider those tests as a measure of our ability to properly pack the shipping case rather than a measure of the quality of the shipping case.

We use the burst test to determine the bursting strength of the combined board and to check the information on the Box Makers' Seal. For our use we have been unable to determine a correlation between the burst test results and the ability of the corrugated shipping case to properly protect its contents. It will, however, give you an indication of the quality of some of the raw materials used in making the corrugated shipping case.

At this point I wish to give you a word of caution. Do not be guided too much by what we are doing. Your products may require different tests. Study your own problem and reach your own conclusions without any preconceived ideas as to which test is best for you. Then if you believe that a program similar to ours is in your best interest, then and only then, should you adopt it.

We use compression as one of our tests for accepting or rejecting receipts of corrugated shipping cases. It has been our experience that faulty manufacture, such as leaning corrugations, crushed corrugations, loose liners, overly heavy

E. H. BALKEMA, Colgate-Palmolive-Peet Co., Jersey City, N. J.

Nalco #680

STABILIZED *Sodium Aluminate*

100% Soluble • 100% Stable • 100% Available

NALCO 680 is *completely* soluble, *completely* stable . . . the one sodium aluminate that remains in solution as sodium aluminate and does not settle out.

Every ounce of Nalco 680 provides active alkaline alumina . . . always available for rapid reaction. That means reduced alum requirements, lower acidity, better sizing, better retention, and therefore, better products.

Read the results reported at right — then ask a Nalco Representative to show you how Nalco 680 can repeat them in your mill.

BOX BOARD MILL — Power Savings

"Machine tenders report much better sheet formation with Nalco 680, and that jordans can be cut back 10 amps. Machines are cleaner with no deposits on cylinders."

KRAFT MILL — Alumina Retention

"Improvement in sizing, better retention of alumina, and general texture of the sheet using Nalco 680 are very marked. Converter reports the sheet handles better."

SULFITE BOND MILL — 45% Less Alum

"Results using Nalco 680 at the rate of 5 pounds per ton have been good. Improved sizing and reduced alum so that 140 pounds of alum is being added per 4500 pounds of furnish, instead of the previous 250 pounds of alum. This enabled the mill to meet rigid pH specifications for the paper."

TISSUE MILL — Clean Machines

"No. 6 paper machine remaining clean and generally good results through the use of Nalco 680 applied at the rate of four pounds per ton into the fan pump suction."

NATIONAL ALUMINATE CORPORATION

6197 W. 66th Place • Chicago 38, Illinois

Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario

THE Nalco SYSTEM ... Serving the Paper Industry through Practical Applied Science

printing impressions, wide score lines, heavy finger marks etc., will be reflected in the compression tests. It will be noted that these are all items which are directly under the control of the manufacturer and, therefore, they are his responsibility.

Our present compression test standards were developed in cooperation with Container Laboratories Inc. and adopted Jan. 2, 1949. These compression requirements are held to the minimum which is acceptable to us and allow for normal operating inperfections with the case still passing the specified tests. To illustrate, not infrequently test results on top to bottom compression will exceed 150% of the standard. This is the test which is of primary interest to us because we desire good stacking qualities.

It would be well at this time to discuss the use of these standards. Let us assume that we have a corrugated shipping case which with its contents weighs 45 pounds; that its length is 14 inches, width 10 inches, and depth 11 inches. The printing on the four side panels is 10% of the area of those panels.

Under the provisions of Rule 41, a 200-pound test case would be required. If maximum top to bottom compression is desired, "A" flute would be specified.

To determine the standard for top to bottom compression the perimeter must be determined. This is equal to twice the length plus twice the width or 48 inches. By referring to a chart we find that the standard is 740 pounds and that there are no correction factors for shape or printing.

The end to end compression standards are determined in the same manner as the top to bottom compression standards, except that the perimeter in inches is equal to twice the width, plus twice the depth or 42 inches for the case we are using as an example. Using a chart, the standard is found to be 640 pounds.

If the empty cases are tested and they meet or exceed the standards before compressing $^3/_4$ of an inch on the top to bottom compression test or $^5/_8$ of an inch on the end to end compression test, then these standards can be used to determine the height to which the cases can be stacked. Our experience indicates the load which the bottom corrugated case in the stack will support over a long period of time is about 50% of the top to bottom compression. This would be one half of 740 pounds or 370 pounds.

This 370 pounds divided by the shipping weight of 45 pounds per case indicates that the bottom case will support eight fully packed cases. Therefore, these corrugated shipping cases with their contents can safely be stacked nine high under normal storage conditions.

For top to bottom compression testing of the empty case we generally seal the top and bottom flaps with gum tape. For end to end compression testing the top and bottom flaps must be glued. The bottom flaps are easy to glue as they can be held in position until the glue is dry, by means of weights placed inside the case.

The top flaps are a little more difficult to seal. To do this, we put glue on the top flaps and then place a board of the proper size on the inside of the case. A bolt is located in the middle of this inside board. This bolt extends from the inside to the outside of the case through the space where the two outside top flaps meet. A second board of the same size and construction as the inside board is placed on the outside and the two bolted together, thus holding the top flaps in position during the drying period. We generally allow the cases to condition 24 hours at 50% relative humidity and 72 to 74°F before testing. When they are tested, the top board is removed and the inside board is dropped into the case in a diagonal position where it has no effect on the test results.

Sometimes rooms having constant relative humidity and temperature are not available for the proper conditioning of the cases. To overcome this lack of adequate equipment, we sometimes select a room which has a fairly constant relative humidity and we determine the relative humidity at the time the cases are placed in it for conditioning and again at the time they are tested. We then take an average of the two readings and by means of a chart furnished to us by one of our suppliers, we apply a factor to the compression test reading which we believe gives to us a reading which is approximately the same as we would get under standard test conditions. While I do not recommend this method, it can be helpful to you if you do not have a constant relative-humidity conditioning room.

In these compression tests, the amount of load-carrying capacity of the individual case is determined. It has not yet been established that the ability to withstand vertical strains parallels the ability of the case to carry its contents safely through periods of rough handling. It does, however, give results which can be used as standards for checking the cases before they are used and it definitely shows the advantages of vertical corrugations where stacking qualities are required, especially where the contents cannot be used to support the weight. It also reflects the difference between "A", "B", and "C" flutes, the materials used in making the board, the shape and size of the case, and the amount of printing on the case.

WRITTEN SPECIFICATIONS

We have written specifications for each corrugated shipping case that we purchase and I strongly recommend to you that you do the same. If you do not have adequately written specifications, how can you reasonably expect your suppliers to furnish you with the cases you want? In writing these specifications it is important to determine first what is desired of each corrugated case in terms of the item packed in it. When that is established the actual writing of the specifications is not very difficult. In this manner all the essential information can adequately be given to the supplier.

These specifications should include inside measurements, kind of stock to be used, flute, type of manufacturers joint and material to be used in making the joints, vertical or horizontal corrugations, type of case, printing copy, number to a bundle and how packed for delivery, and of course, the standard test which the case must pass.

We use "A", "B," and "C" flute cases for different purposes, depending on the protection desired. Here are a few typical examples.

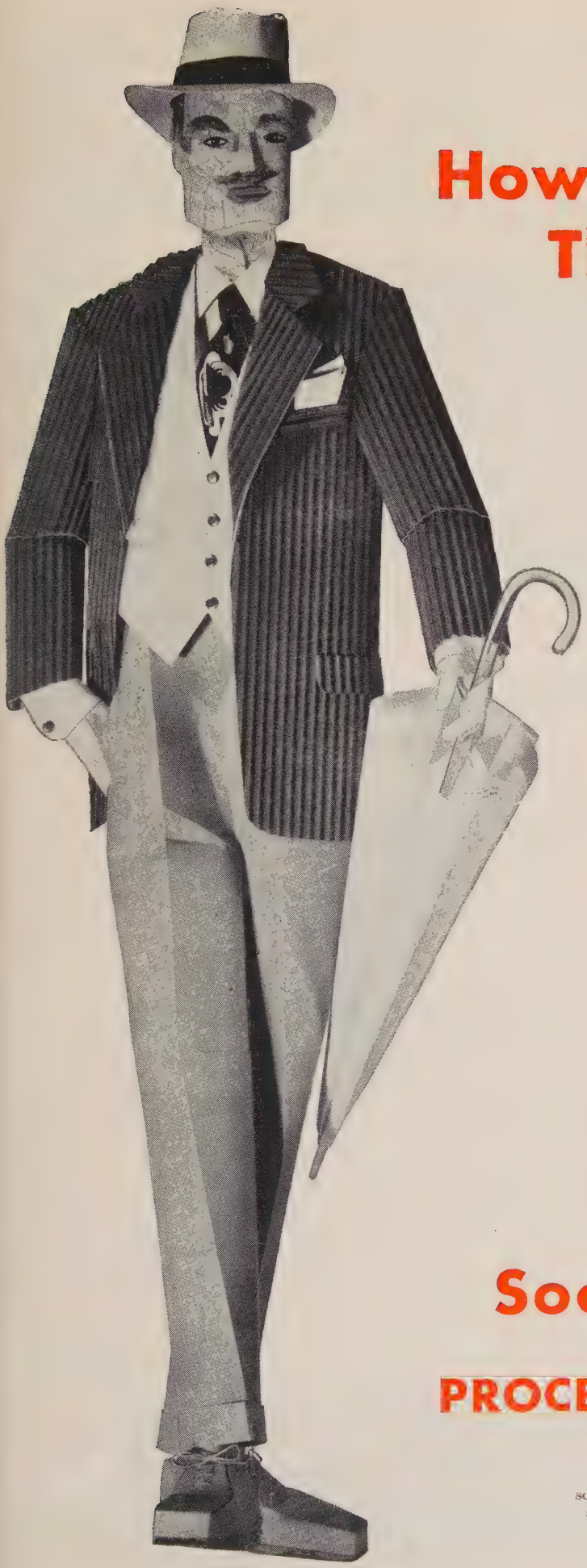
1. "A" flute is preferred for the packaging of glass items but we will accept "C" flute. We do not consider "B" flute satisfactory for glass items.
2. If high end to end compression is desired we use "B" flute.
3. If high top to bottom compression is desired we use "A" flute.
4. For cases with a stitched manufacturers joint we prefer "B" flute.

Each specification sheet shows the inside dimensions for the corrugated shipping case. By inside dimensions we mean the maximum size of a solid block having parallel sides which can be placed in the case and have the flaps properly closed.

I believe it is safe to say that most producers of corrugated shipping cases can and will meet, within reasonable limits, the specified sizes for length and width.

I believe it is also safe to say that the majority of those same producers do not make cases of the proper depth. Recently I had the opportunity of checking inside dimensions of corrugated shipping cases against the written specifications at various locations, extending from the East Coast to the West Coast. It is interesting that the vast majority of our suppliers was incorrectly interpreting the depth dimension although they knew what was desired.

By way of explanation, let us assume that the case is made of "A" flute corrugated board, having a thickness of $^3/_{16}$ inches. The normal method used by the suppliers to determine the depth dimension is to measure the distance between the centers of the top and bottom score lines and subtract $^3/_8$ inches. Therefore, if the measurement between the cen-



How to SIZE UP This Man!

S/V Ceremuls...for beater or top sizing—offer all these advantages for different kinds of paper.

- HAT . . . *Bristol Stock* . . . S/V Ceremuls raise size efficiency.
- HAIR . . . *Carbon Paper Stock* . . . S/V Ceremuls reduce curl.
- FACE . . . *Map Paper* . . . S/V Ceremuls improve softness, size and printability.
- COLLAR . . . *Coated Paper* . . . S/V Ceremuls plasticize starch and clay coatings.
- TIE . . . *Wall Paper* . . . S/V Ceremuls improve hanging characteristics.
- COAT . . . *Corrugated Stock* . . . Special Products improve corrugation.
- VEST . . . *Butchers' Wrap* . . . S/V Ceremuls improve grease-proofness.
- UMBRELLA . . . *Drinking Cup Stock* . . . S/V Ceremuls add water repellency.
- PANTS . . . *Boxboard* . . . S/V Ceremuls improve fold and printability.
- SHOES . . . *Corrugated Box* . . . S/V Ceremuls add scuffproofness.
- SHOE STRINGS . . . *Paper Twine* . . . S/V Ceremuls add softness and pliability.

Socony-Vacuum

PROCESS PRODUCTS

Process Products SOCONY-VACUUM

SOCONY-VACUUM OIL COMPANY, INC., 26 Broadway, New York 4, New York.
and Affiliates: MAGNOLIA PETROLEUM CO., GENERAL PETROLEUM CORP.

ters of the score lines is $10^3/_8$ inches they would tell me the inside dimension for the depth would be 10 inches.

This line of reasoning is not basically true and has caused us considerable trouble with tight packs. If you analyze this problem you will find that when each side flap is folded the depth of the case is reduced by one half the thickness of the stock so, therefore, the folding of the two outside flaps will reduce the depth by $^3/_{16}$ inches. To this must be added the thickness of the two end flaps or $^3/_8$ inches. This makes a total of $^9/_{16}$ inches which must be subtracted from the $10^3/_8$-inch dimension obtained by measuring the distance between the centers of the score lines, thus resulting in a depth of $9^{13}/_{16}$ inches instead of 10 inches.

Most of the technical representatives, of our suppliers, when first approached with this line of reasoning, tend to argue that their method is correct and they state that they have had little trouble with size and have been using the present method of determining the depth dimensions for many years.

To demonstrate our point the Colgate packaging engineers developed an inside caliper which is adjustable in size. We have used it many times in discussing the measurement of the inside dimensions of corrugated shipping cases and to date we have always been able to prove our statements to our supplier's satisfaction.

The control laboratories at each of our plants have a set of these measuring devices which they use daily for measuring each incoming shipment. Figure 1 is given so that if you wish to make and use the same or a similar device for measuring your corrugated shipping cases you are welcome to do so.

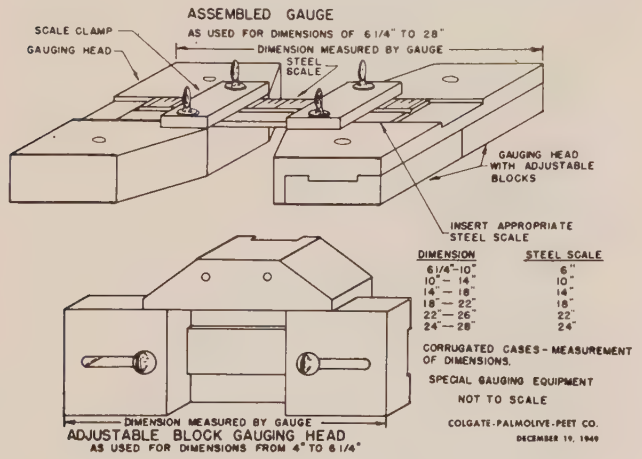


Fig. 1

You may be interested in knowing that many of the larger and better known suppliers of corrugated cases have made similar devices during the last 2 months and are now using them to advantage. It is our standard practice to measure all inside dimensions using a set-up squared case and the measuring device. We do not accept measurements based upon score lines and allowances.

PAPER TAPE

Now I would like to discuss a subject which I believe should be developed in the interest of economy. That subject is paper tape. We believe that there is a definite need for a moisture and moldproof paper tape. We have tested many samples from various sources of supply located in the East, Mid West and in the West. Also, we have worked with the producers of paper tape. To date we have found only one paper tape which is satisfactory from our viewpoint. There must be other moisture and moldproof paper tapes on the market which can be economically used by the case manufacturer in regular production, if we knew where to look for them.

You may be interested in knowing that we have compression tested corrugated shipping cases with the manufacturers joint made of 47-pound liner stock and that the test results ranged up to 150% of the standards for top to bottom compression.

COMMERCIAL TESTING LABORATORIES

We use the services of commercial testing laboratories to check the results which we obtain in our own testing laboratories. We also recommend, and in some instances we insist, that our suppliers have some of their cases tested by commercial testing laboratories.

Why do we do this? First we want to be sure that our demands are fair and that our test results are reasonably correct. Our second reason concerns our suppliers. We want them to know the quality which they are producing including the faults which they can correct only if they know what is wrong. One rejection for bad quality will pay for a lot of testing.

I have no interest in trying to sell you on the merits of any commercial testing laboratory. I am only reporting to you our experiences with them either through direct contacts or through contacts made by our suppliers. However, if you are in need of help, I am sure that you can get it from commercial testing laboratories specializing in corrugated shipping cases. Why not present your next problem to one of them, along with your supplier, and tap this source of information for your benefit. We have tried it and we like the results we obtained.

In conclusion, I present to you a check list of questions.

1. What do you expect of your corrugated cases?
2. What written information have you given to your supplier?
3. Does your supplier know what you want?
4. Have you a definite quality control?
5. Do you test your cases or have them tested by outside laboratories?
6. Are your tests tailored to your individual requirements?
7. Are you continuing your search for better quality?
8. Are you also continuing your search for more efficient applications which will reduce your cost?

Presented at the Annual Meeting of the Technical Association of the Pulp & Paper Industry, New York, N. Y., Feb. 20–23, 1950.

DISCUSSION

Mr. Brown: Have you measured the improvement in quality due to this quality control program?

Answer: No, and we still have damage. The test cases are inspected at several points in process and in distribution and we believe the damage is held to a minimum.

Mr. Brown: Which in your opinion is the best flute case for your products, A, B, or C?

Answer: We prefer A or B flutes, and the tendency in the industry is back to A and B flutes rather than C. The A flute is for compression box and the B flute is for can box.

Mr. Hamilton: Do you take the maximum compression or the compression at $^3/_4$ of an inch?

Answer: We use compression at $^3/_4$ of an inch. If the maximum is reached before $^3/_4$ of an inch, we use the maximum.

Mr. Hamilton: Do you have any allowance for shape of case or printing in determining the box compression?

Answer: In the case of printing, yes, provided the printing is exceptionally heavy (that means in area). A percentage is also allowed for other than normal case sizes.

Mr. Balkema: How much do you consider a board can be crushed and still have a good quality box?

Answer: This is a difficult question to answer in that crushing normally occurs only at certain points such as feed rolls, pull rolls, and under printing plates. Minimums must be set for the crushing at these points.

Mr. Brown: Is there any value in testing unconditioned board directly off the combiner?

Answer: No.

Mr. Burnett: What size foot do you use on your caliper for obtaining caliper of corrugated board?

Answer: One inch.

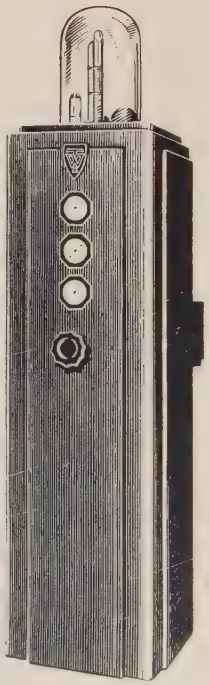
Mr. Hamilton of Container Corp. stated that they had discontinued using one inch foot and were now using a quarter inch foot, conforming to TAPPI standards.

Results YOU CAN SEE

with BREAK-POINT CHLORINATION BY W&T

The photograph gives graphic evidence of why Break-Point Chlorination is so effective in eliminating slime in paper mill fresh water supplies. This process, carefully fitted to individual needs by W&T Engineers and applied by dependable W&T Chlorinators, has proven itself in hundreds of modern paper mills all over the country. Such results are obtained because Break-Point Chlorination attacks and destroys the basic cause of slime—bacteria. It does this efficiently and quickly by means of reliable W&T Chlorinators whose effective operation is based on sound design and precision manufacturing — all backed by the accumulated knowledge of over 35 years' continuous experience in every phase of chlorination.

Your nearest W&T Representative—one of a nationwide W&T Service Organization—will be glad to give you details on Break-Point Chlorination for your fresh water supply and chloramine or chemical treatment for stock and white water system. Take the first step toward a slime-free mill. Call him today.



WALLACE & TIERNAN
COMPANY, INC.
CHLORINE AND CHEMICAL CONTROL EQUIPMENT
NEWARK 1, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES

I-29

Mr. Brown: What is a good flat crush for A flute board?

Answer: Mr. Farrah stated that flat crush varied considerably with the amount of printing and the dimension of the case, and he considered a crush of 30 p.s.i. a very good board.

Mr. Gillespie: Are test cases conditioned before testing, and if so, for how long?

Answer: Yes, cases are conditioned at 50% relative humidity and 73 °F. for a minimum of 6 hours before testing.

Mr. Brown of Ball Brothers stated that they consider 4 hours preconditioning and 6 hours conditioning before testing to be the minimum requirements.

Controlling Container Quality

G. A. FARRAH

You may have heard the phrase "quality of product is essential to continuing success." It sounds good, but let us analyze it. Webster can give you a definition of the word "quality" in words. Can you express in words what quality means in a corrugated shipping container? I have tried. You may say that a quality container is one which carries the goods to the end of the line. This does not cover the multitude of controls necessary to get the quality box to the shipper. A quality container is the summation of controls from the tree to the finished product.

Let's see how such a system of quality control works in an integrated operation from the tree to the finished shipping container.

To begin, a long-range program must be organized to assure the pulp mill of a plentiful supply of wood of the right species. A staff of experts in silviculture, reforestation, and wood utilization has to be maintained. It is a well-known fact that trees cut at one season of the year may yield pulps of different characteristics than those cut at another time of the year. These men guide us in doing the right thing.

The whole process of pulping requires close control in making the necessary chemicals, cooking the wood chips, recovering the spent liquors, and finally in the refining and preparation of the pulp for the paper machine. At every point along the process, standards are set up for the chemical ingredients, steam pressures, temperatures, and freeness of stock on the paper machine. We have seen many statistical methods for controls on paper machines, in addition to the many mechanical gadgets that are used in papermaking. After so much effort has been put into the making of the paper from which corrugated boxes are made, it is surprising how some container manufacturers revert to the old time "feel" method for controlling quality. This is not the case in most modern box shops.

It is difficult to put an evaluation on the loss of profits due to poor quality. The cost of labor and materials can be determined and runs into five figures annually for the average plant. The loss of good will and the aggravation to the customer cannot be measured, but you can be sure it more than equals the direct costs.

The establishment of controls in the converting plant requires the maintenance of an experienced staff, well trained in all the phases of the manufacture of shipping containers. The first step requires an intelligent analysis of statistical data from various sources. Second, establish standards and determine how closely you measure up to these standards. The third and most important step is doing something about the poor quality which you may find.

Let us take these steps individually. From commercial testing laboratories and public institutions, a wealth of knowledge can be obtained. In order to make a laboratory analysis of the performance of a container, it is necessary to have rather expensive equipment and trained personnel. It is not only expensive, but time-consuming. The compression test is a generally accepted method of the measure of the quality of a box, but is not fitted for a control test. It has been found that there is a relationship between the flat crush resistance and compression. It is a broad relationship, and this particular point is controversial. We have found, however, that the loss in caliper due to crushing the flutes influences the flat crush resistance of combined corrugated board. The flat crush resistance is an indication of the rigidity of the board. So, by logical deductions, we decided to use the loss of caliper method as a spot quality control test to reduce the amount of crushing and make more rigid corrugated board. We found that if the caliper of the corrugated board reaching the shipping department was the same as the caliper of the board as it left the corrugator, a more rigid box was the net result. The results of hundreds of compression tests were analyzed and indicated that we were on the right track.

The second step in the program called for setting standards not only for the caliper losses at each of the various operations but also standards for all the physical strength characteristics of incoming materials, and making spot checks on shipments of paperboard being received. Any deviation from these accepted standards demands immediate action.

Standards for the caliper of the combined board are based on the depth of cut of the corrugator rolls, the type of machine, and the manufacturer of the machine. The maximum allowable crush is determined for each point in the combining operation where crushing can occur. The ultimate goal is to get fabricated combined corrugated board of the specified caliper with no crushing or malformations of the flutes.

The controlling of crushing of the combined board at the printer-slotter is a much more complicated procedure. You may get crushing from the feed rolls, the printing cylinders—there are generally two sets of pull rolls—and crushing along the scorelines by the slotter heads. It is essential that all of these points be watched carefully and that the crushing be kept to the specified minimums.

The taping and stitching operations require the use of pull rolls to move the boxes through the machines. On the taping machines, the pull rolls start the application of tape to the manufacturer's joint. Pressure is required and consequently the strength of that taped edge is affected if too much pressure is used.

Most normal size boxes are stitched on automatic equipment today. Pull rolls are used to move the boxes through the stitchers. I have seen box failures due to excessive pull roll pressure at the stitching machines.

Constant checking of these pull roll damages and crushing of corrugations will give the basis for immediate action. Machines can be adjusted so that the standards can be met. But in addition, it is well to have a more thorough investigation of container quality. For this type of an investigation, the compression test is used. The actual test results are compared with established standards and an efficiency rating can be obtained.

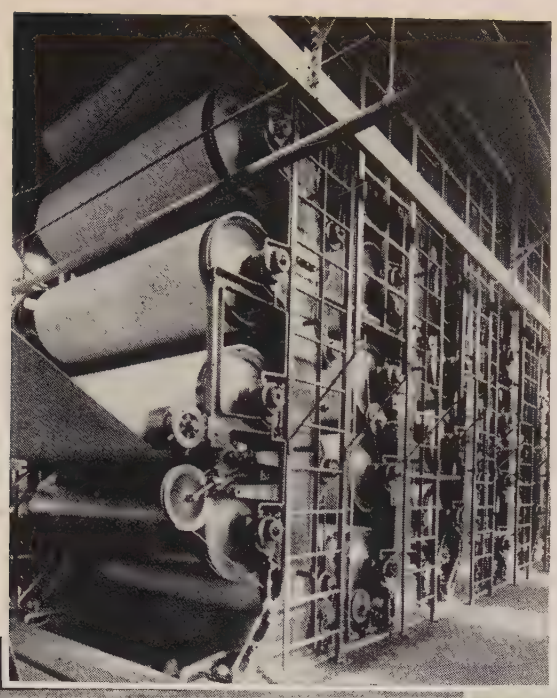
The collected data on caliper losses and compression tests are charted and trends can be observed. The operations needing attention will be brought to focus so that any necessary changes in equipment can be made.

To further improve quality a thorough follow-up system of all complaints is necessary. In general, 95% of all the orders will run through the plant correctly without any special attention. It is the small minority of orders that give the headaches.

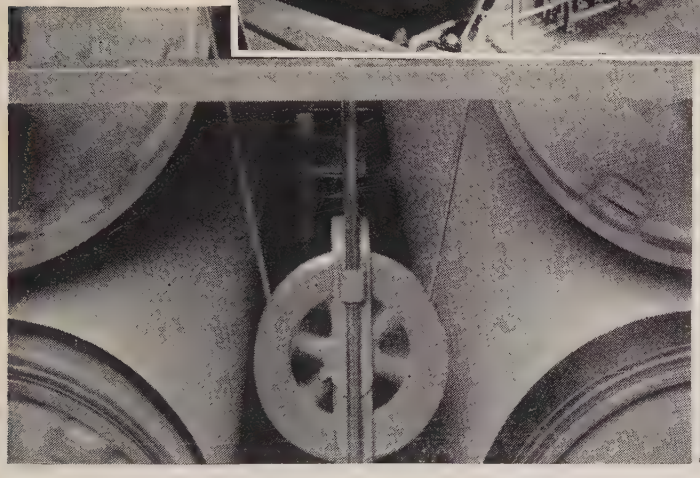
An analysis of complaints will reveal that the quality failure will fall into one of three categories.

1. Carelessness on the part of the worker who may have any number of things on his mind, when he should be concentrating on the job he is doing. In this category we find those errors

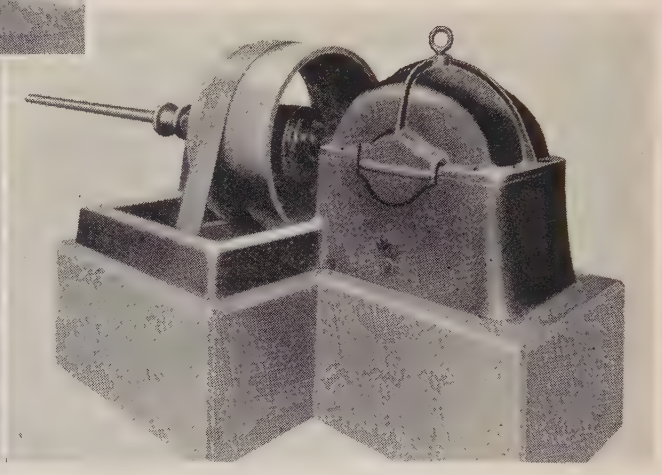
G. A. Farrah, Technical Director, National Container Corp., Long Island City, N. Y.



DRYER MODERNIZATION



Sheahan rope carrier for safety and faster sheet carry over.



B-C spiral bevel gear drive for dryer sections.

B-C SEAMLESS DRYERS

Many thousands in service and failures negligible.

B-C BOLTED HEAD DRYERS

Mills that prefer this type will be accommodated.

Over the years, it has been the privilege of Black-Clawson to increase the tonnage of many a mill by enlarging its dryer sections.

Where machine room space was adequate, double and triple deck sections were often extended. When space was lacking and a building program threatened, old dryers were often mounted in vertical stacks and additional ones installed.

Perhaps a dryer modernization program would permit faster operation and greater tonnage at your mill. If so, Black-Clawson would be glad to estimate for you the cost of the improvement.

New machines, cylinder or Fourdrinier, rejuvenation of older machines. Finishing end equipment, drives etcetera.

THE BLACK-CLAWSON CO.
Hamilton, Ohio

DIVISIONS: SHARTLE BROS. MACHINE CO., MIDDLETOWN, OHIO • DILTS MACHINE WORKS, FULTON, NEW YORK

WESTERN SALES OFFICE: Mayer Bldg., Portland, Oregon
Associate: Alexander Fleck Limited, Ottawa, Canada

Subsidiary: B-C International, Ltd., 16 Catherine Place, Victoria, London S.W.1, England

such as crooked boxes, poor printing, faulty taping or stitching and the like.

2. Those errors in layout which result in waste of materials, machine time, and costly extra operations, due to office mistakes.

3. The result of ambiguous instructions from the customer, which are not clearly defined. Such errors result in wrong size, wrong color ink, or errors in copy.

After a complete investigation is made, certain recommendations follow so that there will be no recurrence. All the information can be noted on one printed form showing the origin of the complaint, the investigation, recommendations, and the final disposition. An integral part of any such system is the contacting of those persons who were responsible for the quality failure, pointing out the cost of their error to the company.

I have given you a brief outline of an inspection system which has been put into practice in quite a few plants throughout the country with some degree of success. But the collection of these data is of no value unless it is properly presented to the operating personnel who are directly responsible for quality failure or improvement. Periodic quality meetings of each of the departments will very often result in suggestions for doing a particular job better. Written, clearly-defined job procedures should be published and distributed fixing the responsibility and authority for each job. These job sheets stress three things: (1) quality, (2) production, (3) waste. Quality, production, and waste are made the direct financial responsibility of every worker.

In order to do a good job of quality control, top management must provide the necessary tools in the form of personnel and equipment, not only in the laboratory, but also in the plant. Materials which meet standard specifications must be provided, for it is folly to believe that even with good operations, a first-grade quality merchandise can be made from substandard components. You can't make a silk purse out of a sow's ear.

Modern up-to-date equipment, properly maintained is also a "must." Thorough, periodic check ups on all operating equipment, with a view toward preventative maintenance, will pay dividends in more production, better quality, and fewer costly shutdowns.

The training of plant personnel can be achieved through monthly unit meetings at which the desirable as well as the undesirable examples of quality are displayed. The reasons for quality failure are discussed and the costs of errors are reviewed. When the people of every level in your plant make quality their own personal business, quality improvement is bound to follow.

A well-equipped laboratory staffed with adequate personnel of the proper caliber with a definite program can furnish the production department with yardsticks and tools for guidance. It should not be the sole responsibility of the Quality Control Department to improve quality. The responsibility should and must rest with the operating personnel. Very often the operators may try to pawn off the responsibility to an inspector. But if the two team up and work together, the daily problems will be solved much quicker.

None of the techniques discussed here are a substitute for technical skill, improved machine performance and proper maintenance. Quality control programs help get the facts for management so that any inadequacies are brought to focus for remedial action. However, these techniques will improve quality and production, will help control waste, and make for better customer satisfaction.

Quality of product is essential to continuing success, but the control of quality is the underlying secret to successful continuation.

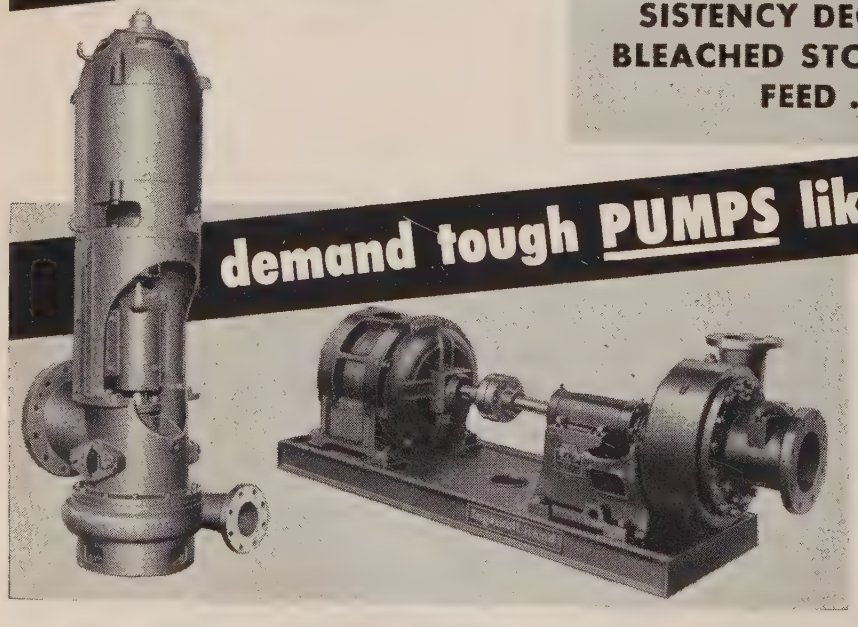
Presented at the Annual Meeting of the Technical Association of the Pulp & Paper Industry, New York, N. Y., Feb. 20–23, 1950.

Editorial Note: Mr. Farrah's company affiliation was incorrectly given in the Annual Meeting program published in *Tappi*. He is Technical Director of the National Container Corp., Long Island City, N. Y.

tough stock-moving jobs like these . . .

. . BULL SCREEN . .
BLOW PIT . . BROWN STOCK . . HIGH CONSISTENCY DECKERED STOCK . . HEAVY BLEACHED STOCK . . BROKE . . MACHINE FEED . . COUCH PIT, etc.

demand tough PUMPS like these . . .



The ability of Ingersoll-Rand pumps to handle the many stock-moving jobs in paper mills has been thoroughly proven . . . *in actual service.* They're tough — they stay on the job — and with a minimum of maintenance.

• • •

Let an I-R engineer tell you about the features of these vertical and horizontal stock pumps. Ask for your copy of Bulletin 7022 describing the complete line of I-R pumps for pulp and paper mills.

Ingersoll-Rand
11 Broadway, New York 4, N. Y. 406-10

DU PONT *for* PIGMENT COLORS

WALL PAPER
COATED PAPER
FLINTED PAPERS
BEATER DYEING

STANDARDIZED PIGMENTS to MEET the EXACTING REQUIREMENTS for PAPER COLORING

THE DU PONT LINE includes economical pigments of highest quality. There are colors for beater dyeing which have been especially processed for quick and thorough dispersion in water. They have better strength than the usual lakes for beater coloring. Use them for papers which must have good lightfastness.

All these Du Pont pigments are standardized for properties important to their use in paper. They may be adapted to the most exacting requirements.

You can get further information from your Du Pont salesman, or by writing to E. I. du Pont de Nemours & Co. (Inc.), Pigments Department, 1007 Market Street, Wilmington 98, Delaware.

DU PONT PIGMENTS for QUALITY PRODUCTION

Chrome Yellow ☆ Organic Yellow Lakes ☆ Soluble Blue
Pigment Green B—full strength and lakes ☆ Molybdate Orange
Dispersible "Monastral" Blue and Green Lakes ☆ Toluidine Red
Watchung Red ☆ PTMA—Blue, Green and Red Lakes

● Tune in to Du Pont "Cavalcade of America," Tuesday Nights—NBC coast to coast

DU PONT
REG. U. S. PAT. OFF.

...ER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

DU PONT
PIGMENTS
FOR PAPERS

THE PACIFIC-NORTHWEST . . . a backdrop of primitive grandeur brought alive by the power-giving Columbia cascading out to the blue Pacific. Here, too, midst a mingling of backwoods and metropolis, fighting fish, canneries, lumber mills and freshly irrigated agricultural wealth, you'll find the paper industry. And, practically all of these mills already know that *Appleton Wires are Good Wires!*

APPLETON WIRE WORKS, INC., APPLETON, WISCONSIN

© APPLETON WIRE WORKS, 1950

THE FUTURE OF YOUR PRODUCT IS IN THESE HANDS

wet-strengthen your paper with the UFORMITES

A million hands test your product—the hands of your customers' customers, who demand *wet strength* in paper.

To satisfy these ultimate users—and their suppliers—wet-strengthen your paper with the UFORMITES, quickly, easily at low cost. As little as $4 per ton of paper boosts wet Mullen values 300%, raises dry Mullen and fold values 10% to 30%, and increases wet rub and scuff resistance, and wet and dry tensile. No pretreatment, special equipment or special processing is necessary.

Full technical information on the UFORMITES is yours for the asking.

OTHER CHEMICALS FOR THE PAPER INDUSTRY

RHOZYMES BB and E-5—for enzyme conversion of starch.

TAMOL N—for effective pitch control—a dispersing agent for pigments.

TRITONS—Surface-active agents with a score of uses in paper manufacture—in caustic cooking of cotton fiber, as a dispersing agent for pigments and metallic soaps, emulsion-type coatings.

The Hydrosulfites—Reducing agents for stripping color from rag stock or for bleaching pulp.

HYAMINES—Deodorants for paperboard and glue bactericides.

UFORMITE, RHOZYME, TAMOL, TRITON, HYAMINE *are trademarks, Reg. U.S. Pat. Off. and in principal foreign countries.*

CHEMICALS FOR INDUSTRY

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square Philadelphia 5, Pa.

The Resinous Products Division was formerly The Resinous Products & Chemical Company

Divisional Chairmen

The following divisional general chairmen have been appointed by Albert E. Bachmann, President of the Technical Association:

Engineering Division—George H. Pringle, Mead Corp., Chillicothe, Ohio.
Testing Division—James d'A. Clark, Consultant, Longview, Wash.
Pulp Manufacture Division—Fred C. Goodwill, St. Regis Paper Co., Kalamazoo, Mich.
Paper Manufacture Division—A. L. Sherwood, Sutherland Paper Co., Kalamazoo, Mich.
Converting and Consuming Division—M. L. Downs, Thilmany Pulp and Paper Co., Kaukauna, Wis.
Industrial Division—Werner Kaufmann, Kupfer Bros. Paper Co., Chicago, Ill.
Research Development Division—H. W. Bialkowsky, Pulp Div., Weyerhaeuser Timber Co., Longview, Wash.

New Committee Chairmen

Materials Handling Committee—A. P. Schnyder, Ebasco Services, Inc., New York, N. Y., succeeded George R. Wadleigh, Consultant, New York, N. Y.
Drying and Ventilating Committee—M. L. Barker, Beckett Paper Co., Hamilton, Ohio, succeeded A. E. Montgomery, J. O. Ross Engineering Co., Chicago, Ill.
H. F. Parker, New York & Pennsylvania Co., Lock Haven, Pa., succeeded M. F. Fogerty, Sutherland Paper Co., Kalamazoo, Mich. (deceased).
J. R. Lientz, Union Bag & Paper Corp., Savannah, Ga., is Chairman of the new Digester Corrosion Subcommittee of the Chemical Engineering Committee.
Graphic Arts Committee—Fred D. Elliott, Time, Inc., Laboratories, Springdale, Conn., succeeded R. H. Simmons of the Government Printing Office, Washington, D. C.
Coating Committee—J. H. Heuer, St. Regis Paper Co., Deferiet, N. Y., succeeded Werner Kaufmann, Kupfer Bros. Paper Co., Chicago, Ill.
Corrugated Container Manufacturers Subcommittee—F. D. Long, Container Corp. of America is organizing this committee.
Mechanical Pulping Committee—F. W. O'Neil, New York State College of Forestry, Syracuse, N. Y., succeeded R. M. Drummond, International Paper Co., Glens Falls, N. Y.

All other committee chairmen were reappointed.

TAPPI-CPPA Fundamental Research Conference

A Fundamental Research Conference, dealing with the subject "The Effect of Fiber Characteristics on Paper and Papermaking Properties" will be held in Quebec City on May 29–31, 1950, at the Chateau Frontenac. This conference, which is sponsored jointly by the Fundamental Research Committee of the Technical Section, Canadian Pulp and Paper Association, and by the corresponding committee in the Technical Association of the Pulp and Paper Industry will include papers and discussions on the various aspects of the papermaking characteristics of fibers by authorities in the respective fields. The general chairmen of the meeting are the chairmen of the two committees, W. Gallay of the E. V. Eddy Company of Hull, Canada, and H. F. Lewis of the Institute of Paper Chemistry, Appleton, Wis.

The subjects, speakers, and discussion leaders are as follows:

A. The Individual Fiber Properties Related to Papermaking

1. Fiber Dimensions and Physical Structure (Monday 9:15 a.m.)

   Discussion leader—C. B. Purves, McGill University, Montreal, P. Q.
   (1) "The Effect of Variations in Size, Shape, etc.," by Gerald Haywood, West Virginia Pulp and Paper Co., Luke, Md.
   (2) "Orientation of Fine Structure," by George L. Clark, University of Illinois, Urbana, Ill.
   (3) "Degree of Crystallinity and Distribution of Crystalline Cellulose," by Merle Heath, The Institute of Paper Chemistry, Appleton, Wis.
   (4) "Molecular Weight Considerations" by M. O. Schur, Ecusta Paper Co., Pisgah Forest, N. C. and H. F. Lewis, Institute of Paper Chemistry, Appleton Wis.

2. Strength and Mechanical Properties (Monday 2:00 p.m.)

   Discussion leader—Milton Harris, Milton Harris Associates.
   (1) "Tensile strength, etc., Flexibility, and Stress-Strain Curves," by J. A. Van den Akker, The Institute of Paper Chemistry.
   (2) "The Relation Between Individual Fiber Properties and the Quality and Use Requirements of Textiles," by Milton Harris.

3. Surface Properties and Managements (Tuesday 9:15 a.m.)

   Discussion leader—James d'A. Clark, Consultant Longview, Wash.
   (1) "Surface and Specific Volumes,"
   (2) "Electrokinetic Characteristics," by S. G. Mason, Pulp and Paper Research Institute of Canada, Montreal, P. Q.
   (3) "Submicroscopic Surface Effects": (a) "Electron Micrographic Technics," by I. H. Isenberg, J. H. Herschleb, The Institute of Paper Chemistry, Appleton, Wis., and (b) "Cine Photomicrographic Technics," by H. F. Lewis and Olga Smith, The Institute of Paper Chemistry, Appleton, Wis.

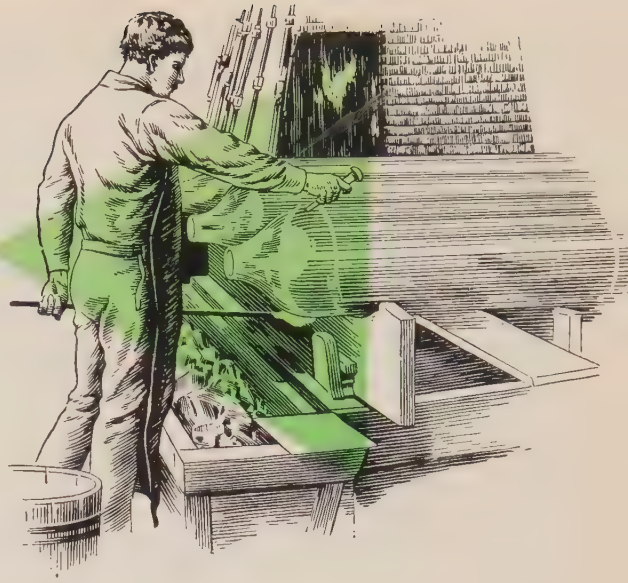
B. Inter-Fiber Properties Related to Papermaking

1. Fiber-Water Relationships (Tuesday 2:00 p.m.)

   Discussion leader—W. Boyd Campbell, Pulp and Paper Research Institute of Canada, Montreal, P. Q.
   (1) "Principles of Polymer Swelling," by Herman Mark, Polytechnic Institute of Brooklyn.
   (2) "Swelling of Cellulose Fibers, Measurement and Significance."
   (3) "Effect of Drying on Swellings," by W. Gallay, The E. B. Eddy Co.

as you were in 1900

Glass-making involved many arduous, cumbersome and even dangerous processes, as did such industries as soap, paper and textile manufacture, water purification and sewage treatment.



as you are today

Many new methods and improved materials take the guesswork —and the hazards —out of modern glass-making.

...with 50 years of service by Niagara Alkali

One of the world's oldest industries is very young in ideas. That's why glass-making has made such strides toward efficiency of operation, quality of products and safety of its workers in the last 50 years.

Fifty years spell progress at Niagara Alkali, too. A pioneer in American production of liquid chlorine and caustic soda, and now observing its fiftieth anniversary, Niagara has shown consistent progress by the development of new and better chemicals which, in turn, stimulate progress in the fields it serves: paper, soap, glass, textiles, sewage treatment, water purification and others.

NIAGARA ALKALI COMPANY

60 East 42nd Street, New York 17, N. Y.

Liquid Chlorine • Caustic Potash • Carbonate of Potash • Paradichlorobenzene • Caustic Soda
Niagathal (Tetrachloro Phthalic Anhydride) • NIALK TRICHLORethylene

(4) "Bound Water and Hydration," by Alfred J. Stamm, Forest Products Laboratory.
(5) "Flocculation and Formation," by S. G. Mason, Pulp and Paper Research of Canada.

2. Fiber-Fiber Bonding (Wednesday 9:15 a.m.)

Discussion leader—C. C. Heritage, Wood Conversion Co.

(1) "Measurement and Nature of Fiber-Fiber Bond," and
(2) "Effect of Drying on the Bond," by Loren V. Forman, The Institute of Paper Chemistry.
(3) "Problems in Fiber Bonding with Natural Additives," by John W. Swanson, The Institute of Paper Chemistry.
(4) "Progress and Problems in the Bonding of Fibers by Synthetic Resins," by Chester Landes, American Cyanamid Co.

C. Effect of Chemical Composition of Fibers on Papermaking Properties (Wednesday 2:00 p.m.)

Discussion leader—H. F. Lewis, The Institute of Paper Chemistry, Appleton, Wis., L. G. Cottrall, Albert E. Reed & Co. Ltd., Larkfield, Kent, England.

Reservations should be made with George Jessop, Manager, Chateau Frontenac Hotel, Quebec, P. Q.

The Technical Section of the C.P.P.A. will hold its summer meeting at the same place on May 31, June 1–2, 1950. Members of TAPPI are welcome to attend this meeting.

We invite your requests for technical assistance on problems relating to the usage of starches, gums or dextrines.

PENICK & FORD, LTD., INC.

420 LEXINGTON AVENUE, NEW YORK, N. Y.

Manufacturers

FACTORY—CEDAR RAPIDS, IOWA

Offices

NEW YORK, N. Y. CEDAR RAPIDS, IOWA

Pays A Nice Dividend in Space

THE 3" THICK STEBBINS CARBON BRICK LININGS,

the result of fifteen years research to perfect a thin brick lining for sulphate digesters and auxiliary equipment, in place of 5" thickness, is now available to:

minimize the loss of digester volume due to space occupied.

be readily installed in existing digester shells

prove resistant to all types of corrosion encountered under varying cooking conditions

place no limitation on operating procedure

be resistant to thermal shock

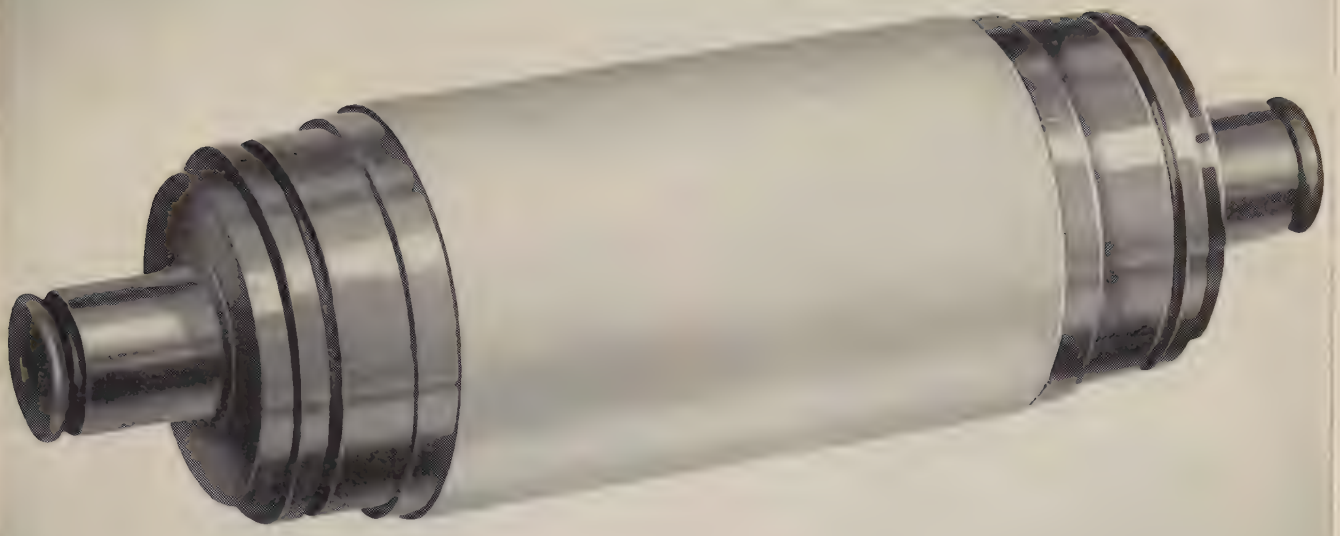
be resistant to abrasion

Write department "C" for more complete information on the advantages of this 3" carbon brick lining.

SEMCO

Stebbins Engineering and Manufacturing Company

EASTERN BOULEVARD, WATERTOWN, NEW YORK



Perkins Calender Rolls are the natural result of the longest and broadest experience in this highly specialized industry.

B. F. PERKINS & SON, Inc.

ENGINEERS AND MANUFACTURERS

HOLYOKE, MASS.

LARGEST MANUFACTURERS OF CALENDER ROLLS IN THE WORLD

The Role of the Chemical Engineer in the Pulp and Paper Industry

G. W. E. NICHOLSON

DURING THE VERY early days of our industry, a free exchange of ideas was not general. There was a great deal of secrecy among the pulp and papermakers. The need for specialized, theoretical knowledge began, however, to be felt and the chemists eventually entered into the picture. In this connection, a quotation from the August, 1888 issue of *Paper World* may be of interest: "The Bremaker-Moore Paper Company of Louisville, Ky. now have four Bremaker patent sulphite boilers in successful operation. This company has a female chemist who is an expert in her profession, and gives entire satisfaction in her work."

Gradually the plants increased in size and their operations became more and more complex, requiring the knowledge of a trained engineer. Until fairly recently, say some ten to fifteen years ago, the activities of the chemical engineer and the chemist were largely limited to the laboratory, testing raw materials and samples of chemicals from the process, as well as samples of pulp and paper. In those days he did not participate very actively in the actual operation except in a more or less advisory or service capacity. To a certain extent this applied also to other branches of engineering such as mechanical, electrical, etc. The equipment used was to a great extent designed by the equipment manufacturers and the arrangement of the equipment as well as the development of the processes used depended to a very great extent upon the years of practical experience gained by the operators. In those days pulp and paper manufacture was an art, and in many cases the superintendent and manager were guided by the rule of thumb.

As years passed by more and more engineering graduates entered into the pulp and paper industry, as they did in all other industries. It became more and more frequent that the manager in charge of the pulp and paper mill was an engineering graduate, and in those cases particularly we find a greater appreciation of the importance of the application of the graduate engineer's technical know-how. Many of these operating heads with an academic education had started after their graduation at the bottom of the ladder as common laborers and worked up through the ranks through foreman and superintendent and they were the ones who had a particularly good understanding and appreciation of the value of the combination of thorough fundamental technical knowledge together with years of practical experience.

I believe I can truthfully say that it is only through the introduction of the scientifically trained engineer that the pulp and paper industry during most recent years has been able to keep in step with other industries in introducing and applying the most efficient methods, equipment, and processes as used today. The combination of his theoretical knowledge together with his practical experience is of such importance that I do not see how any of our large modernly equipped pulp and paper mills could operate successfully without such guidance. A uniform quality and a low cost of the finished product require the application of the most precise and keenest understanding of modern science. Such know-how can best be brought into the picture through the engineer, whether it is the chemical engineer, the mechanical engineer, the industrial engineer, the electrical engineer, or any other special branch of engineering—as well as human engineering.

As my assignment here today is to talk about the role of the chemical engineer in the pulp and paper industry, I shall have to confine myself to this particular branch.

As I see it, the chemical engineer has a tremendous field open to him in our particular industry and I feel it is up to us in management to see that we take full advantage of his knowledge. To do so we should have a definite plan worked out for the young chemical engineering graduate in order to give him the practical experience so that he may be able to apply his theoretical knowledge to the best advantage. The success of such training and application will depend very much upon the organizational setup. It is of utmost importance that the young engineer be thrown in intimate contact with the actual operation with the least amount of complications.

Probably the most satisfactory plan in the long run is for the young high-school graduate to work as a laborer in the pulp and paper mill for a year or so before he enters the university for engineering studies, and continue to obtain practical experience every summer semester until he graduates, and from there again continue in the plant working up through the ranks as foreman and superintendent.

Such a method of introduction can be made very effective in combination with scholarships given by the company to sons of employees, with the selection of high-school graduates based upon scholastic standing as well as leadership ability, together with expected performance in the plant during the training period as well as at the university. This arrangement will also help to bring about good morale and good understanding between management and workers.

Another method of introducing young engineers is through the organization of a Processes Engineering Department. Such a department can be of utmost help in assisting efficient operation and can be organized in several groups of two to three engineers, with a group leader in charge of each group, working on various operating problems in the plant. Such a department

G. W. E. NICHOLSON, Vice-President in Charge of Manufacture, Union Bag & Paper Corp., New York, N. Y.

5 GOOD REASONS . . .

why you should specify FARREL CALENDER ROLLS

BULLETIN 116
FARREL ROLLS
FOR PAPER MILLS
1. Extreme hardness of roll surface prolongs original accuracy and lengthens time between regrindings (see p. 9).
2. Correct depth of chill means the roll may be re-ground many times before its usefulness is ended (see p. 9).
3. Precisely graduated crown, exactly symmetrical on both halves of roll, assures correct compensation for loading and weight of rolls in stack (see page 10).
4. Rolls not requiring crown made round and straight to extremely close tolerances (see page 10).
5. Before Farrel calender rolls can pass inspection they must be stacked and "light-tested" (see page 12).

This *NEW* 16-page bulletin gives the "how" and the "why" of these five Farrel features; explains how chilled-iron rolls are made, and how the roll maker's experience, skill and plant facilities are reflected in the quality of the finished product.

Farrel calender rolls are made in the *world's largest specialty roll shop*–a shop that has been serving the paper industry for close to a century.

FARREL-BIRMINGHAM COMPANY, INC. • ANSONIA, CONNECTICUT

Plants: Ansonia and Derby, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Pittsburgh, Akron, Chicago, Los Angeles, Houston

FB-561

[PTI]

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.

Please send me a copy of your new bulletin 116, "FARREL ROLLS FOR PAPER MILLS".

*Name*_____ *Title*_____

*Company*_____

*Address*_____

*City*_____ *State*_____

Farrel-Birmingham

should be dovetailed most intimately with the operation, thus bringing about a two-way development of practical and technical know-how. The young engineer working in this department comes in very close contact with all the various phases of the plant operation and can thereby be trained and prepared for operating jobs in the plant. Such a department of process engineers, if actively and intelligently directed will exercise a tremendous influence upon the plant operation, by applying technical knowledge to practical know-how, thereby developing improved methods, improved processes, as well as improved equipment.

This kind of setup will also bring about an increased interest and knowledge on the part of the intelligent workers in the ranks, and the final outcome of such coordination will mean a happy combination of the keenest minds, with and without technical education, all the way from the ranks up to the top management of the plant.

The operational teamwork can also be further developed if the plant operation is based upon decisions made by the supervisory groups at regularly held meetings, particularly if such groups consist of technically educated as well as practically trained men.

The chemical engineer has a tremendous field open to him in our particular industry, not only in pulp and paper mill operation as such, with its various chemical processes, but also in the design of the equipment and its application. Efficient operation of modern pulp and paper mills today cannot be obtained unless the various stages in the processes are under the most careful continuous control, and our ultimate goal must be an automatically controlled continuous operation from the woodyard to the end of the paper machine.

To bring about such results, a most intimate knowledge of the chemical processes, as well as application of various phases of engineering knowledge are required, and only through continuous studies and analyses is it possible to reduce losses of chemicals, water, fiber, steam, and other valuable materials. This also applies to interruptions due to poor layouts, faulty installations, as well as unsuitable metals and material used in the equipment. Furthermore, the maximum production can be obtained only by continuous knowledge at all times of the operating efficiency of the equipment at the various stages, whether it is through the application of complete instrumentation or through periodical checks by the operator as well as the technical men.

The tremendous size of the capital investment in large pulp and paper mill plants today makes it imperative that every modern device in the form of instruments or otherwise be used to bring about the most efficient operation. Here again technical know-how is required. I need only to mention a few instances such as operation of large boilers at pressures above 1200 pounds; evaporators with as many as seven effects; the most modern large recovery units complete with electrical precipitators for the burning of kraft waste liquor; new pulping processes such as magnesium and sodium bisulphite; bleaching plants with as many as eight to nine stages; modern continuous causticizing plants with large units of kilns for reburning of lime; application of automatic regulation of steaming and gassing of digesters; continuous cylinder washing in several stages of brown stock as well as bleached stock; modern installations of refining equipment such as disk refiners, jordan refiners, and beaters.

Another territory where the chemical engineer is today playing a very great role is in the treatment of the paper stock with chemicals before as well as on the paper machine, giving special characteristics to the sheet such as increased wet strength, water resistance, and vapor resistance, etc.

Considering the introduction of large wide paper machines running at machine speeds up to 2000 f.p.m., a continuous and accurate control of the quality of the pulp made as well as the refining of the pulp and the addition of chemicals and the drying of the sheet are of utmost importance. Here again we have an application of chemical and physical testing as well as instrumentation. Such control is also closely tied in with the maximum paper machine efficiency required without any breaks of the paper on the paper machine. Other factors, such as bacteria control in the paper mill system enter into the picture, as well as the need for improved performance of machine clothing requiring special knowledge of bacteriology, metallurgy, as well as textile technology.

There is a very fertile and almost untouched field for the chemical engineer in our industry in the improvement of fiber quality and yield from various species of wood under various conditions of aging of wood. We have so far applied very little knowledge to a greater economical utilization of various species of wood for various grades of pulp, and it is quite possible to think that some day we will evaluate a cord of wood by the fiber quality and the fiber content.

Other wide areas have been opened up for the chemical engineer during recent years, such as the utilization and recovery of by-products in our industry. I am particularly referring to turpentine, tall oil, alcohol, yeast, and lignin. Such by-products will be further developed into end products through work carried out by the chemical engineer, and it is quite feasible to think that our industry in the future will not only supply important organic chemicals as raw material for various industries in the organic chemical field but that we also will see chemical plants combined with our pulp mills for the manufacture of finished products. Almost every large company in the pulp and paper industry has already taken steps in such a direction.

The employment of chemical engineers in large pulp and paper mills today by plant organization as briefly outlined will undoubtedly be more and more developed in the maintenance of an uninterrupted operation at maximum efficiency, bringing about the lowest cost product. Such introduction and intimate contact with plant operation will also give engineers with leadership ability opportunities to move into operation as supervisors and managers, and at the same time it will also help to educate the practical men in the ranks, giving them a greater opportunity for promotion to various supervisory positions. In this manner will we be able to bring forward the best informed and most capable men for leadership in the industry.

Presented at the Annual Meeting of the Technical Association of the Pulp & Paper Industry, New York, N. Y., Feb. 20–23, 1950.

Continuous Improvement Benefits All!

This credo of
QUALITY
is the main-spring of all
COLOR
research, product
development and
technical service at Ciba.
IN this way . . . and for
more than sixty years
. . . we have been able to
provide sound and up-to-date
counsel on the proper
selection and effective use of
DYESTUFFS
FOR all types of
PAPER
If you seek improved and more uniform results with colors for beater . . . calender . . . and coating processes, you are invited to discuss your problems with Ciba's technical service representatives.

CIBA

CIBA COMPANY INC.

627 GREENWICH STREET, NEW YORK 14, N. Y.

Boston Chicago Charlotte
Providence San Francisco Philadelphia

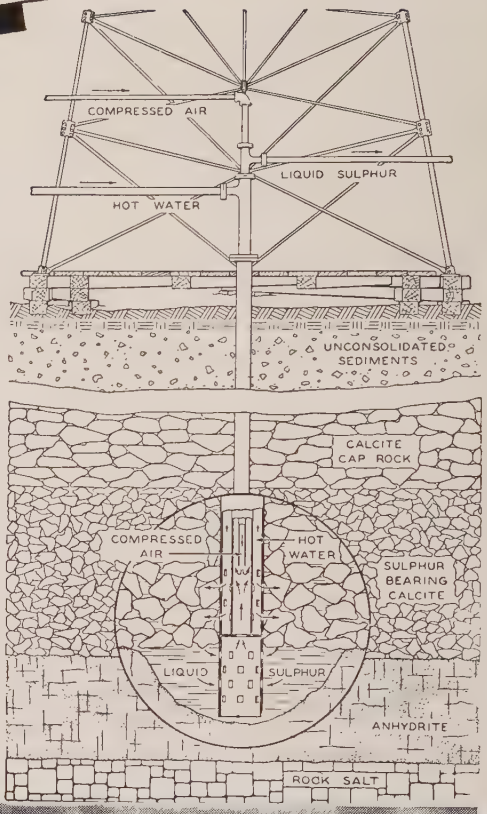
SULPHUR

*Interesting Facts Concerning This Basic Raw Material from the Gulf Coast Region

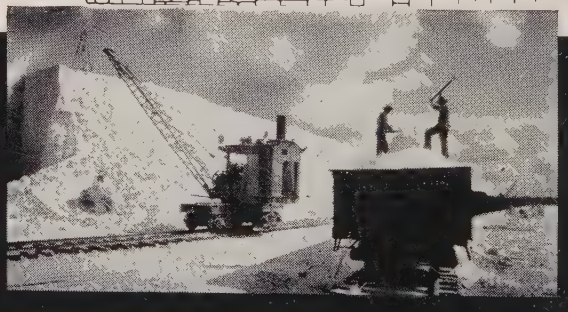
*WELL PIPING

The well equipment consists of pipes of various sizes, placed one within the other and extending from the surface into the sulphur deposit. A 10" or an 8" casing extends to and rests on the top of the cap rock. A 6" pipe, inside the casing, passes below it and reaches into the barren anhydrite. It is perforated at two different levels, separated by an annular collar. The upper set of perforations permits the hot water to enter the sulphur formation and the lower set permits the entrance of the molten sulphur to the discharge pipe fitted inside the 6" pipe.

When a well is "steamed" the hot water passes down the annular space inside the 6" pipe and outside the sulphur pipe and flows through the upper set of perforations into the porous formation. The entire mass through which the hot water circulates is raised to a temperature above the melting point of sulphur. The liquid sulphur being heavier than water, makes its way downward to form a pool and displaces water around the foot of the well, and rises in the well column through the lower perforations into a 3" pipe which is the sulphur discharge pipe. Compressed air released at the bottom of still another pipe fitted inside the 3" pipe rises and mixes with the sulphur column, forming an air lift which raises the liquid sulphur free of water to the surface.



Loading operations at one of the huge vats of Sulphur at our Newgulf, Texas mine. Such mountains of Sulphur are constantly being built at our mines, from which shipments are continually made.



TEXAS GULF SULPHUR CO. INC.

75 East 45th St. New York 17, N. Y.

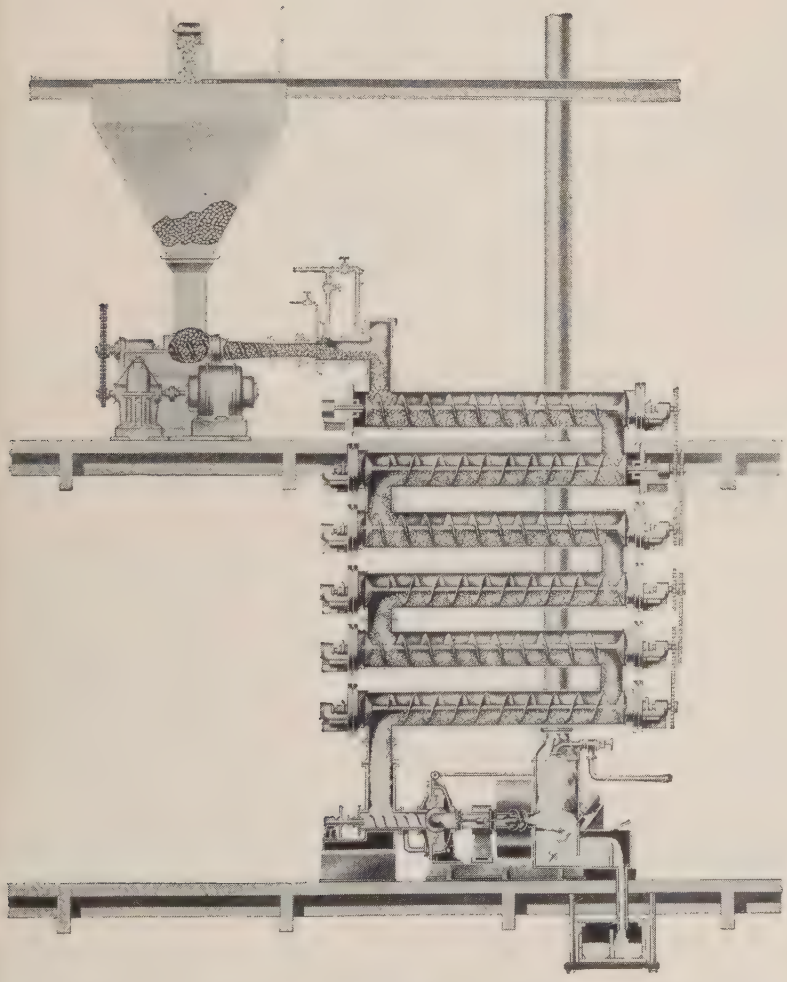
Mines: Newgulf and Moss Bluff, Texas

CHEMIPULPER

(Patented and Patents Pending)

The Continuous DIGESTER

FOR CONTINUOUS COOKING OF CHEMICAL AND NON-CHEMICAL PULPS



The CHEMIPULPER is a modern, *continuous* digester, now producing uniform pulp in over fifty operating units in U. S. mills, at a surprisingly low cost.

Such pulp is used for making insulating board; flooring, roofing and automotive felts, and corrugating board. Other grades of pulp are made from either hard or soft woods, or mixtures of such woods.

Operates continuously in 150 to 175 p. s. i. steam pressure range. Uses either neutral sulphite or alkaline liquors.

Cooking factors of time, temperature and chemicals adjustable to conform to variables in raw materials and accurately meet predetermined requirements.

The Reaction Chamber is made in units and the number of these can be varied according to the degree of treatment required.

Reaction Chamber with continuous flight conveyor screws insures positive and uniform feed from inlet to discharge end of chamber.

Reaction Chamber screw speeds are adjustable by varying speed of Reaction Chamber Drive.

Illustration shows combination of Asplund Defibrator with multiple-unit Reaction Chamber.

•

Engineered and Designed in collaboration with

LINK-BELT COMPANY

LUKENS STEEL COMPANY

ALLOY FABRICATORS, INC.

•

Catalog upon request

PAPER and INDUSTRIAL APPLIANCES, INC.
122 EAST 42nd STREET NEW YORK, N. Y.

PLASTICS AND PAPER CONVERTING— REVIEW OF LITERATURE FOR 1948

Prepared by Plastics Committee Subcommittee Plastics and Paper Converting

A survey of the literature on the use of plastics in the paper converting industry for the year 1948 indicates that there is a definite growing interest in elastomers and synthetic rubbers. Two factors have been largely responsible for the increased use of this type of compound: (1) the availability of the resins as water dispersions, and (2) the versatility of specific resins properties as obtained by co-polymerization of various monomers. There is also a definite interest in the production of functional films, using resinous base laminants and coatings.

The survey is divided into sections according to the method of application or the end use of the resinous product. In some cases, certain articles should be duplicated in one or more sections; however, for simplicity, any such duplication has been eliminated.

Solvent Coatings

(1) Aiken, William H. Plastics as paper coatings. Modern Packaging 21, no. 11: 193–197 (July 1948).

A review of the application of many plastic coatings to paper is given describing their qualities of waterproofness, moisture vapor transmission resistance, greaseproofness, gas transmission and many other characteristics of the coating sheets. Plastics included in the descriptions are cellulose derivatives, polystyrene, cyclized rubber, various vinyl polymers, polyethylene and zein.

(2) Cornish, G. W. Polyethylene. Org. Finishing 7, no. 3, 26–30.

A brief description of the use of polyethylene resins in coating applications.

(3) Gordon, Phillip. Coating resin. U. S. pat. 2,430,564 (Nov. 11, 1947). Assigned to the American Waterproofing Corporation.

A colorless transparent hard rubbery plastic resulting from the co-polymerization of vinyl acetate and a dialkyl ester of maleic acid is described as a protective coating resin.

(4) Maier, Curtis E. Paper coating. Canadian pat. 446,122 (Jan. 13, 1948). Assigned to the Continental Can Company, Inc.

The patent describes the use of a resinous coating for paper comprising a co-polymer of vinyl chloride and vinyl acetate, a plasticizer and a petrolatum. The coating is claimed to be flexible and has a tough impermeable surface. Some other resinous coating compositions are also mentioned.

(5) McGill, John H. Paper coating. U. S. pat. 2,439,051 (April 6, 1948). Assigned to Imperial Chemical Industries Ltd.

A coating composition comprising a polyvinyl chloride dispersion in a solution of polymethacrylic ester of a saturated aliphatic alcohol is described. Claims are made of advantages in elimination of surface stickiness, and it is also stated that a dull finish can be obtained which retains its appearance well.

(6) Parsell, J. P. Plastics testing in the paper mill laboratory. Paper Trade J. 126, no. 16, 55–57 (1948).

A study of methods of testing of coated, impregnated, and laminated papers prepared with the use of synthetic resins is described.

(7) Titell, L. and Berk, S. Coatings on kraft. Modern Packaging 21, no. 4: 165–167, 202 (Dec., 1947).

A study of the moisture and mold resistance of some types of solvent coating materials applied to kraft paper is described. Incorporation of fungicides in the lacquers was found necessary. Some varnishes are described which have good resistance to certain types of fungi.

Reference is also made to a Saran lacquer-coated paper.

Water Dispersion Coatings

(8) Field, G. E. Vinyl-nitrile blends. Modern Packaging 22, no. 4: 149–150, 190, 193 (Dec., 1948).

A description is given of the basic properties of vinyl-nitrile rubber blends. The specific compound (a blend of Geon polyvinyl chloride and Hycar nitrile rubber in latex form) is discussed and tables of the physical properties of the film are presented. The compound makes a good food packaging material, since it is greaseproof and retains its flexibility even at −50 °F.

(9) Jennings, Harley Y. Coated paper and method of producing the same. U. S. pat. 2,432,074 (Dec. 2, 1947).

A 25 or 40-lb. kraft paper which has been supercalendered and slack sized is coated on one side. The sheet is then treated in a latex bath and then dried and tightly rolled. The product is a latex-coated paper which has a film of sufficient thickness to distort or stretch even though the backing paper is ruptured.

(10) Martin, Ray C. Emulsion impregnation. TAPPI Bull. No. 83: 1–2 (Jan. 19, 1948).

A generalized discussion of the impregnation of paper with waterborne emulsions of elastomeric resins and their application by the paper converter or manufacturer. The coverage includes beater addition, wet web saturation and off-the-machine techniques. Information is given on the resinous and rubber systems and some data concerning formulation and compounding.

(11) Partridge, E. G. Latex compounds for the paper industry. Am. Paper Converter 22, no. 4: 9, 24–25 (April, 1948).

A generalized discussion covering the various methods of incorporating latices into paper is given. The compounding of latex to impart desirable properties to the sheet is also covered. Various types of latices and additives are evaluated and many of the problems involved in their use and application are discussed in detail.

(12) Stilbert, E. K. Latices as binders for clay-coated papers. Paper Mill News 71, no. 17: 20 (April 24, 1948).

The article is the condensation of a talk presented by the author before the New England Section of TAPPI. The 512-K latex is a styrene-butadiene co-polymer containing 45% solids which was especially developed as a paper-coating adhesive. A general discussion of the adhesive properties and its compatibility with other adhesives is covered and the material seems to produce almost ideal blends. The compound is an emulsion, however, and care must be taken to control its colloidal stability.

Hot Melt Coatings

(13) Malm, C. J., Salo, M., and Vivian, H. F. Cellulose ester melt coating composition. Ind. Eng. Chem., 39: 168–174 (Feb., 1947).

Contains bibliography.

(14) Salo, M. Butyrate hot-melt coatings. Modern Packaging 20: 127–128 (August, 1947).

The use and applications of cellulose butyrate hot-melt coatings are discussed in generalized terms.

The Subcommittee on Plastics and Paper Converting of the Plastics Committee of TAPPI: Robert H. Mosher, Chairman, Joseph C. Pullman, Ralph Nazarro, Paul Yoder, John Rich, Walder Hardy, Garrison Householder, and Albert King.

Soft!

This fair-skinned beauty could ask for nothing softer than facial tissue made from SOLKA pulp. A personal product like tissue must be soft, strong, absorbent, pleasing in texture—qualities which SOLKA develops to the maximum

Brown Company also offers you full use of their Technical Service Division, to help solve your difficult paper problems. Call on them at any time.

MADE FROM SOLKA

This seal assures your customers a product made from high alpha pure wood cellulose. SOLKA is a specification-built cellulose; the best of its kind

BROWN COMPANY *Foremost Producers of Purified Cellulose*

Pulp Sales Offices:

500 Fifth Avenue, New York 18, N.Y. • 465 Congress Street, Portland 3, Maine
110 S. Dearborn Street, Chicago 3, Illinois • 58 Sutter Street, San Francisco 4, California
Brown Corporation, 906 Sun Life Bldg., Montreal 2, P.Q., Canada

(15) Anon. Ethocel hotmelts for paper coatings. Dow Chemical Co., Plastics Div. Technical Service Bull. 15 p. (1947).

The application of hot-melt coatings to paper, their effect on paper properties (resistance to grease and oils, water-vapor transmission and block resistance in storage), use as adhesives, e.g., in laminating, and odor and toxicity are discussed.

(16) Anon. Coating compositions of polyethylene. E. I. du Pont de Nemours & Co., Inc. U. S. pat. 2,429,-361; Rub. Res. Abs. 26 (1) (1948), 18; Rev. Paint Col. Varnish & Allied Ind., 21 (122), 106 (March-April, 1948).

A solution for the hot-dip coating of objects contains at least 15% by weight of polyethylene having a m.p. between 110 and 165°C. dissolved in an unsaturated hydrocarbon or an unsaturated chlorinated hydrocarbon and containing 15–60% by weight of a saturated hydrocarbon having a b.p. between 110 and 400°C. The solvent phase of the solution boils between 110 and 190°C.

(17) Gates, W. E. F., Davison, J. W., and Worrall, G. W. The coating of sheet materials. British pat. 600,687, Imperial Chemical Industries Ltd.

Methods are given for coating paper and aluminum foil with polyethylene compositions. The resulting laminates are suitable for use as dyestuffs, pharmaceuticals, milk and ice-cream cartons, and moisture and gasproof wrappers and cartons, etc.

Organosol and Plastisol Coatings

(18) Anon. Air blade for coating. S. D. Warren Co. Modern Plastics 25, no. 11: 182 (July, 1948).

Brief description of uses of an air blade in coating.

(19) Anon. Report on German polyvinyl chloride paste dispersions. Rubber Age 62: 539 (Feb., 1948).

(20) Baird, D. K. Polyvinyl chloride—its properties and uses. British Plastics, 20: 227, 167 (April, 1948).

(21) Burleson, M. N. Paste-forming resin used for coatings, moldings and film making. Rubber Age 62: 417 (Jan., 1948).

Two new polyvinyl chloride paste resins are described. Resulting coating can be dipped with aid of preheat. Various products described.

(22) Moulton, M. Scott. Vinyl paste technology. India Rubber World 118: 815 (Feb., 1948).

Present developments in use of vinyl pastes are discussed. Applications in use are described.

(23) Patton, C. W. Vinyl polymers in surface coatings. Official Digest of Federation of Paint & Varnish Production Checks (May, 1948).

Discussions of technology of formulating vinyl-type resins into protective coatings and compatibility with various solvents. Chemical and physical properties of vinyl chloride-vinyl acetate resins are discussed. Also discussed application of vinyl resin to glassine.

(24) Anon. Coated sheet and plastic coating material. Imperial Chemical Industries Ltd., Rev. Gen Caout Doc. Anal. 25, 95 (1948).

(25) Rich, J. H. Organosol and plastisol coatings. Paper Mill News 71: 20 (Sept. 11, 1948).

(26) Ruebensaal, C. F. Paste dispersions of polyvinyl chloride. Modern Plastics 25, no. 10: 143 (June, 1948).

Study of German plastics in manufacture of paste dispersions. Also, discussion of uses to which paste dispersions were put in Germany.

Saturation

(27) Borden, G. C., and Gutkin, S. S. Resins for the paper industry. TAPPI Monograph Series, No. 5 (1947).

(28) Bosso, C. G. Cellulose sheets for decorative and protective uses. Italian pat. 418,219 (Feb. 7, 1947).

Paper treated with glue-glycerine and HCHO for use in wall-papering and suitcase coverings.

(29) Eger, L. W., and Engel, E. W. Impregnated sheet. Canadian pat. 447,990 (April 20, 1948).

A porous web is saturated with unvulcanized co-polymer of butadiene and styrene.

(30) Flood, Wm. E., and Kosinszki, E. Polystyrene impregnated paper. U. S. pat. 2,434,106 (Jan. 6, 1948).

Paper is impregnated with a solution of polystyrene in the presence of catalyst and allowed to polymerize in order to obtain a more uniform distribution of polystyrene.

(31) Jubanowsky, L. J. Coating and impregnating composition. U. S. pat. 2,447,506 (Aug. 24, 1948).

Fibrous materials are impregnated with a mixture of hydrogenerated castor oil and blown castor oil in making gaskets.

(32) Marsh, J. T. and Norbury, J. Treatment of cellulosic materials with phenolic condensation products. Brit. pat. 590,684 (July 25, 1947).

A semicondensation product obtained by the reaction of 1 mol phenol and 2 mols of HCHO in the presence of 4–6% NaOH is used to treat paper, dried, and baked 1–2 min., at 170° showed increased wet strength and dimensional stability.

(33) McLaren, D., and Hofrichter, Jr., C. H. Theory of adhesion of high polymers to cellulose. Paper Trade J. 125, no. 19: 96–100 (1947).

The adhesion of high polymers to cellulose involves a number of physico-chemical principles including the dielectric const. of the polymer, the dipole moment of polymer constituents, hydrogen bonding, etc.

(34) O'Sullivan, J. B. The conduction of electricity through cellulose. J. Textile Inst., T 271–284 (1947).

The conductance of cellulose sheet impregnated with salts. Cellophane sheet was soaked in solutions of NaCl, $NaClO_3$, NaI, $CaCl_2$, $CaSO_4$, $MgCl_2$, $ZnCl_2$, lactic acid, and glycerol of various concns. for 2 days, blotted and dried. Conduction through cellulose is partly and may be entirely ionic. The mobilities of K, Ca, Fe, Cu, Ag, Cl, SO_4, and CrO_4 ions increased rapidly with moisture content.

(35) Scott, Milton J. Dicyanodiamide-aldehyde product. U. S. pat. 2,427,512 (Sept. 16, 1947).

A clear, brittle resin reportedly suitable as a sizing agent for paper.

(36) Stoeckhert, K. Synthetic materials in the artificial leather industry. Kunstoffe ver. Kunstoffe-Tech. u.-Anwend., 37: 5–8 (1947).

The manufacture and materials used in the production of artificial leather are described. Cellulose derivatives are most commonly used.

(37) Straka, C. J. Causes of dimensional instability of paper-base phenolic resin laminates on total immersion in water. Paper Trade J. 126, no. 14: 50–54 (1948).

Data relate to laminates made from absorbent kraft paper.

(38) Upson, C. A. Assembly to prepare laminated sheets of paper or textile fibers. U. S. pat. 2,433,965 (Jan. 6, 1948).

A continuous process is described for impregnating paper or textile webs with a solution of a thermosetting resin and polymerizing in situ.

(39) Van Linge's Chemische Fabrieken. Improving fibrous sheets by plastics. Dutch pat. 61,231 (June 15, 1948).

Condensation products of starch, and an aldehyde to give resins for impregnating fibrous substances.

(40) Voigtman, E. H., and Bletzinger, J. C. Industrial paper. Can. pat. 448,590 (May 18, 1948).

Paper prepared from asphalt emulsion impregnation.

(41) Ward, A. L. Emulsion co-polymer latex for fabric coating, impregnating, and backing compositions. U. S. pat. 2,441,523 (May 11, 1948).

Compounded latices prepared from a copolymer of pentadiene and a styrenoid co-monomer are used to treat paper fibers as well as fabric.

ADVERTISING should start at the wrapping counter

And it does, when retailers use distinctive, *colorful* wrapping paper, cartons and gummed tape. Color makes packages bright, and distinctive. It impresses customers and gives the store free advertising on the street, in buses and street cars.

It's an important *plus* for any retailer . . . and one that's commonly overlooked. So a big market is still open to the company that sells color for its *plus advertising value.*

Our Technical Staff will help you select the proper dyes for colored wrapping paper, cartons and tape. Cost, light fastness and other necessary properties are given careful consideration. Write E. I. du Pont de Nemours & Co. (Inc.), Dyestuffs Division, Wilmington 98, Delaware.

More color makes more business ...for your customers and you

DU PONT BASIC DYES

Du Pont Victoria Pure Blue BO
Du Pont Methylene Blue ZX
Du Pont Auramine Conc.
Du Pont Chrysoidine GN
Du Pont Basic Brown BR
Du Pont Safranine T Ex. Conc. 125%
Du Pont Rhodamine 5GDN Extra
Du Pont Rhodamine B Extra
Du Pont Fuchsine N
Du Pont Methyl Violet S Conc.
Du Pont Victoria Green Small Crystals

DU PONT ACID DYES

Du Pont Orange II Conc.
Du Pont Orange RO

DU PONT DIRECT DYES

Pontamine* Sky Blue 6BX Conc. 150%
Pontamine* Yellow SXP Conc.
Du Pont Stilbene Yellow G Conc.
Du Pont Stilbene Yellow GCB Conc.
Pontamine* Orange R Conc.
Pontamine* Fast Orange WS Conc. 175%
Pontamine* Fast Scarlet 4BS Conc. 150%
Du Pont Purpurine 4B Conc.
Pontamine* Black E Double
Pontamine* Brown D3GN Conc. 125%

* REG. U. S. PAT. OFF.

Du Pont Dyestuffs

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

(42) Weatherford, J. A., and Knapp, F. J. Pliolite Latex-190 in latex compounding. India Rubber World 117: 743–744, 748 (1948).

Data showing the effects of Pliolite latex-190 when added to natural rubber latex, Neoprene latex, GR-S latex (Type 111), and Chemigum latex (Types 101 and 200).

(43) West, Herbert J. Quaternary ammonium salts of melamine-formaldehyde condensation products. U. S. pat. 2,433,802 (Dec. 30, 1947).

Quaternary ammonium salts used in the impregnation of paper, textiles, leather etc., to impart water-repellent properties.

(44) Wilson, Lucius H., Landes, C. G., and Maxwell, C. S. Impregnation of cellulose material. Can. pat. 450,523 (Aug. 17, 1948).

Lamination

(45) Anon. Confectionery production. 14, no. 5: 150 (1948).

Laminated transparent films to paper or foil for candy wraps.

(46) Anon. British Packer, 10, no. 8: 25 (1948).

Description of lamination of cellulose acetate to aluminum foil.

(47) Burgess, L. M., and Abson, G. Canadian pat. 449,390 to H. P. Smith Co. (June 22, 1948).

Adhesive composition of petrolatum and metallic resinate for water vapor resistant lamination of sheet material.

(48) Burgess, L. M., and Abson, G. Canadian pat. 449,391 to H. P. Smith Co. (June 22, 1948).

Adhesive composition of petrolatum, terpene hydrocarbon condensation resin, and aluminum soap for laminating sheet material.

(49) Dreshfield, A. C. Am. Paper Converter 22, no. 5: 10–11, 15–16 (May, 1948).

An application of statistical methods to the control of thermoplastic coating and laminating processes.

(50) Fager, E. P. Canadian pat. 447,133 to Dearborn Chemical Co. (March 9, 1948).

Structure of transparent film coated both sides with a microcrystalline wax compound then laminated to kraft paper on one side and open-mesh fabric embedded in other side.

(51) Glasing, J. S., and Marcotte, H. D. U. S. pat. 2,434,795 to Westfield River Paper Co. (Jan. 20, 1948).

Method and machine for laminating three webs of material by applying laminating cement on center ply.

(52) Holes, Floyd A. Co. Modern Packaging 22, no. 2: 165 (October, 1948); Packaging Parade 16, no. 189: 66, 83 (Oct., 1948.)

Polyethylene lamination to paper, metal foil, or cloth for water vapor resistant packaging material.

(53) Kaess, G. Food 17, no. 206: 331 (Nov., 1948).

Outline of uses of aluminum foil and foil paper laminations in packaging.

(54) Anon. Modern Packaging 22, no. 1: 159–160 (Sept., 1948).

Discussion of water vapor transmission rates of various transparent film laminations.

(55) Noakes, H. F., and Martyn, J. B. U. S. pat. 2,436,596 to E. I. du Pont de Nemours and Co., Inc. (Feb. 24, 1948).

Waxed surface laminated to itself using emulsion adhesive of animal glue and water immiscible solvent for the wax.

(56) Orr, R. T. Bakers Weekly p. 47–48 (June 28, 1948).

Microcrystalline wax laminates of board or paper to paper for bakery use are discussed.

(57) Osborne, K. W. Paper Box and Bag Maker, p. 136 (Oct., 1948).

Description of board lining with aluminum foil.

(58) Swanson, C. A. & Sons, Good Packaging 9, no. 3: 21, 35 (1948).

Cellulose acetate paper labels for metal cans.

(59) Thilmany Pulp & Paper Co. Modern Packaging 22, no. 3: 104–105 (1948).

Wax laminated kraft paper for water vapor resistant barrier.

New Resins

(60) Abramowitz, W. L. Polyisobutylene in waxes. Modern Packaging 21, no. 10: 159 (June, 1948).

The author discusses the improvement in stability of color and melt viscosity which can be obtained in polyisobutylene wax blends when they are properly compounded.

(61) Anon. Wider horizons for plastics. The Lamp (Standard Oil Co. of New Jersey) 29, no. 4: 8 (Sept., 1947).

The resilience and low-temperature flexibility of some resins is discussed. Methods of improving these properties by copolymerization with synthetic rubbers is outlined. Phenolics and vinyls are among the examples covered.

(62) Carter, J. R. Thermoplastic coated papers. Printing Equipment Eng. 76, no. 1: 33 (April, 1948).

The production of labels by coating paper with a resin and crystalline compound to obtain a tacky surface which is capable of adhering to various surfaces is the subject of this article.

(63) Hovey, A. G. Polyamide resins. Paint, Oil and Chem. R. 111: 39–42 (Jan. 8, 1948).

The commercial productions of polyamide resins, obtained as the reaction products of dimerized fatty acids and diamines for paper coating use is outlined. These compounds heat seal readily.

(64) Newberg, R. G., Briggs, J. R., and Fairclough, W. A. S-Polymer films. Modern Packaging 22, no. 3: 151 (Nov., 1948).

The use of co-polymer styrene-butadiene and its advantages for food packaging applications is outlined. Good water vapor resistance, heat sealability, and strong rubbery film characteristics are claimed for the polymers. The coating may be modified by the addition of some of the rubbers.

(65) Nordlander, B. W., and Cass, W. E. Modified wax compatible ethylene glycol-tetra chlorophthalate resins. U. S. pat. 2,455,873 (Dec. 7, 1948).

The patent discloses the preparation of a flame resistant resin which possesses the interesting property of being compatible with natural and synthetic waxes.

(66) Norton, A. J. Furan resins. Ind. Eng. Chem. 40: 236–238 (1948).

The method of preparing such resins is discussed in great detail and the various types of reactions which the furans may undergo is presented at length.

(67) Watson, P. D. Lactic acid polymers as constituents of synthetic resins and coatings. Ind. Eng. Chem. 40: 1393–1397 (1948).

A detailed description of lactic acid polymers is presented. At the present time the recommended cure time is quite severe and this limits their applications. Preparation and formulation studies are presented.

Application and Treating Equipment

(68) Downs, M. C. Proofing of paper. Modern Packaging 21, no. 5: 128–130 (Jan., 1948).

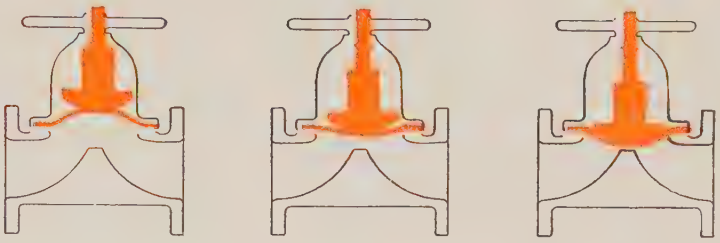
Methods of applying proofing materials to paper are discussed and include (1) hot melt, (2) emulsions, (3) solvent, and (4) film lamination. Some cost data are included.

(69) Haywood, G. Coating paper on the paper machine by the rotogravure offset method. Paper Trade J. 127, no. 3: 59–61 (July 15, 1948).

A doctored knurled roll ("pad roll") picks up the color from a feed roll in the color pan. Transfer is to a rubber-covered roll, P. J. hardness 120 with 1/8-inch ball, in contact with the web backed by a cast-iron roll on the opposite side of the sheet. Application is first to the felt side, followed by partial drying on three drier rolls. Ratio of cup to wall area on the knurled rolls is about 2 to 1. Data are given for cup area and depth vs. coating weight. High solids, up to 75 per cent, and thixotropic "color" is used to prevent sticking and picking on drying cans.

Received Aug. 10, 1949.

If you need a diaphragm valve you need all the advantages of diaphragm closing



Check these popular features of

GRINNELL-SAUNDERS DIAPHRAGM VALVES

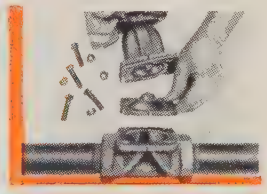
Diaphragm gives leak-tight closure against grit, scale, solid matter . . . Even when something as substantial as an 8-penny nail is trapped on the weir of a rubber lined valve, as illustrated, the resilient diaphragm, plus the large area of contact, gives leak-tight closure against pressure or vacuum.

Diaphragm lifts high for streamlined flow in either direction . . . Smooth, streamlined passage, without pockets, prevents trapping of sludge and reduces frictional resistance to a minimum—irrespective of direction of fluid flow. No disc holder in fluid stream. Grinnell-Saunders Diaphragm Valves are self-draining when installed with the spindle at 15 degrees above the horizontal position.

Diaphragm absolutely isolates working parts from fluid . . . There's no "if" about the way a continuous, one-piece diaphragm seals off the working parts from fluids; no perforation or puncture in the diaphragm where fluid or gas can possibly leak by the valve spindle. No sticking, clogging or corroding of working parts. Valve lubricant cannot contaminate the fluid in the line.

Diaphragm, body and lining materials to meet particular conditions . . . Bodies stocked in cast iron, malleable iron, stainless steel, bronze and aluminum: other materials on special orders. Valve bodies lined with lead, glass, natural rubber or neoprene. Diaphragm materials of natural rubber or synthetics. Working pressure, 150 lbs.; maximum temperature, 180 °F.

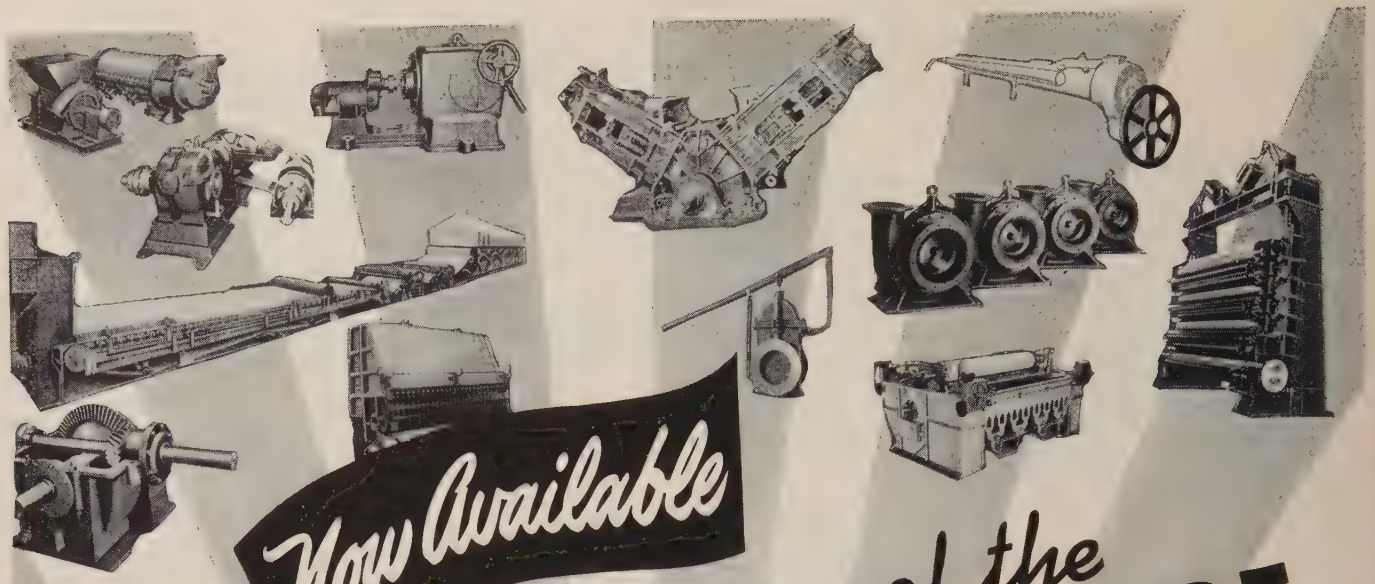
Diaphragm is only part that normally wears and needs replacement . . . Depending on the type of service, it may last for years, particularly since the compressor and finger plate combine to support the diaphragm in all positions. The diaphragm can be replaced quickly without removing valve from line. No refacing or reseating. No disc holder to require tightening or replacing. No packing glands to demand attention.



Write today for the new Grinnell-Saunders Diaphragm Valve Catalog 4-S.

GRINNELL

Grinnell Company, Inc., Providence 1, R. I. Warehouses: Atlanta • Buffalo • Charlotte • Chicago • Cleveland • Cranston • Fresno • Kansas City • Houston • Long Beach Los Angeles • Milwaukee • Minneapolis • New York • Oakland • Philadelphia • Pocatello • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane



Now Available

The New Edition of the Sandy Hill BROCHURE

OF MODERN PULP & PAPER MACHINERY

Bigger, More Complete than the widely acclaimed FIRST EDITION!

Dedicated to the pulp and paper industry as a whole, this new brochure is even more complete than previous editions.

It's a clear and comprehensive outline of the many types of machinery used in the processes leading from raw material to the finished product. If you are a key man in a pulp and paper mill, send for your copy without delay . . . and let us know your particular problem.

Our engineers are anxious to give you every possible assistance.

Sandy Hill Iron & Brass Works

Hudson Falls, N. Y.

Machinists and Founders Specializing in Paper and Pulp Mill Machinery

Some Leading Items:
Fourdrinier Paper Machines
Yankee Fourdrinier Machines
Cylinder Paper Machines
Feltless Wet Machines

Bertrams Flow Distributor
Kamyr Bleaching Equipment
Stock Pumps
Pulp Grinders
"Selective" and Corner Drives

Dandy Roll Drives
Quick Opening Gate Valves
Scofield Felt Conditioners
Cleveland Type Bearings
"Packer" Screens

Shaker Screens
Castings—Iron, Bronze, Aluminum
Neilson Slice
Nilsa Bag Machines
Nilsaton Printing Presses

REPUTATION IS A LIVING THING

Quality is a matter of refinements steadily bred into a product and sensitively cultivated.

General's policy is guided by faithful adherence to fundamentals through fluctuating conditions.

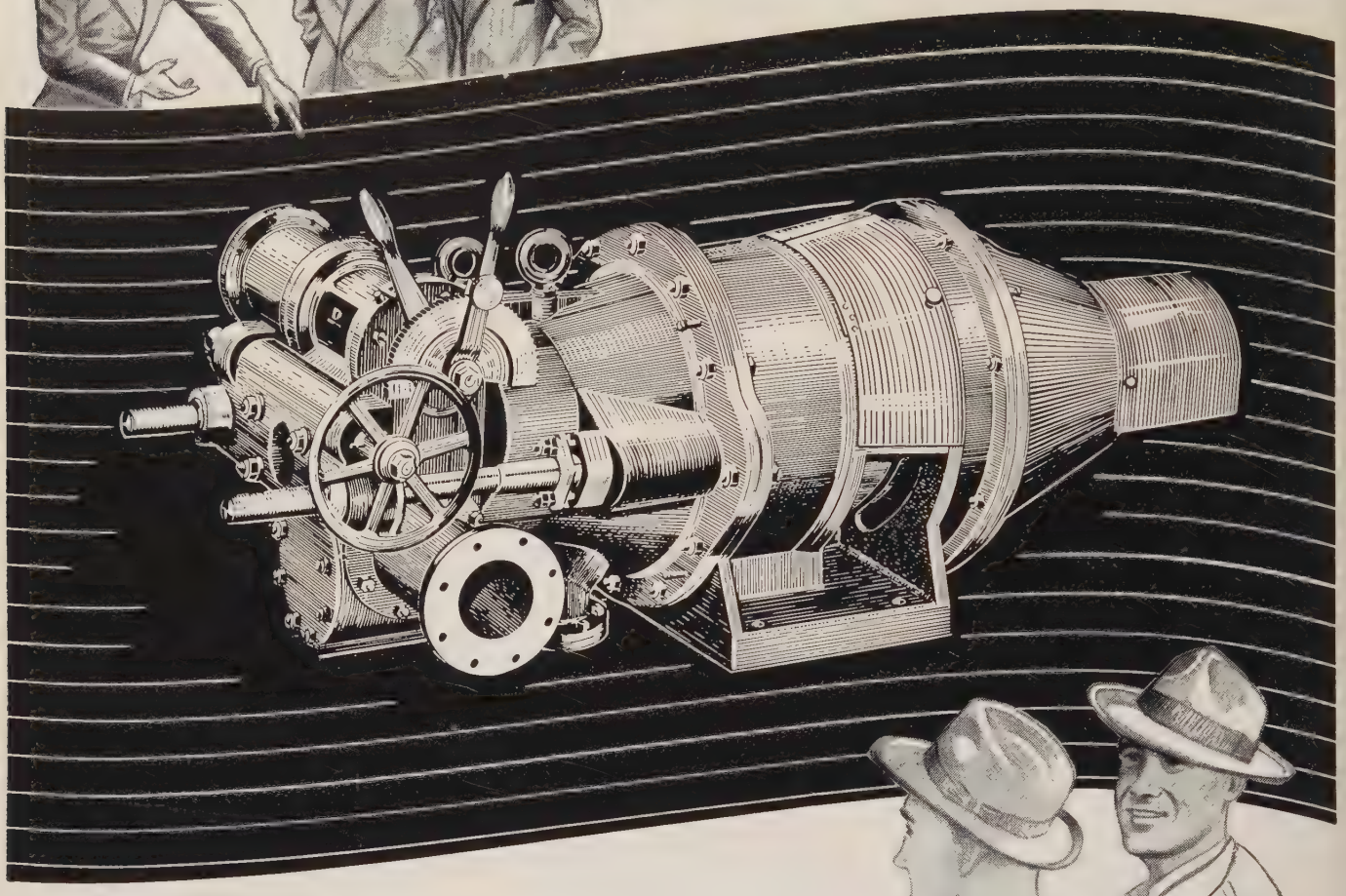
Ours is an attitude of perennial responsibility toward all those who deal with us.

This is how a business becomes planted deeper and deeper in its field of operations.

This is how our business grows and flourishes and its symbol becomes synonymous with Quality.

ENERAL DYESTUFF CORPORATION·NEW YORK

It Is Just Common Sense!



The way

the Morden "Stock-Maker" combines beating or refining into one simple and continuous operation.

More than 350 "Stock-Makers" in over 100 mills have proven its superiority for the vast majority of stock treatment requirements.

May we assist you in surveying "Stock-Maker's" advantages for your particular requirements?

MORDEN MACHINES COMPANY

PACIFIC BUILDING • PORTLAND 4, OREGON

in Canada
The William Kennedy & Sons, Ltd., Owen Sound, Ontario

in England
Millspaugh, Limited, Sheffield

Eastern Sales Representative: Union Machine Company, Fitchburg, Massachusetts

The Effect of Kraft Pulp Mill Wastes on Fish Life

WILLIS M. VAN HORN, J. B. ANDERSON, and MAX KATZ

A study, first sponsored by five Wisconsin kraft mills and later by the National Council for Stream Improvement, has been made of the potentially toxic substances which may be found in kraft pulp mill wastes. Toxicity tests, using sensitive species of fish and fish food organisms, indicated that sulphide, mercaptans, resin acid soaps, and sodium hydroxide constitute the greatest hazards. Methods have been devised for measuring the amount of these compounds in kraft waste waters, and data from the examination of the wastes of five typical northern kraft mills are presented. It is concluded that the amounts of potentially harmful compounds are so small that, when the wastes are diluted in the receiving stream, their concentration is brought below the point where they would be a hazard to fish and other aquatic forms.

Because of the nature of its manufacturing processes, the pulp and paper industry has, for years, been interested in problems relating to stream improvement. Large amounts of water are required in the manufacture of pulp and paper. This water is not a part of the final product but is used, among other ways, as a medium for pulp refining and sheet formation. During the period of its use, solids are added to it, either in solution or suspension, and, when, after use, the water is returned to the stream, these solids can have an adverse effect on the stream.

There are at least three ways by which any industrial or domestic waste, including those mentioned above, can affect the aquatic environment. First, the waste may contain toxic materials which will destroy the animal and plant life; second, it may contain material in solution which will reduce the oxygen concentration in the stream; and third, it may contain substances in suspension, which may otherwise affect the stream.

In the current study, attention has been directed to the first of these three possibilities in relation to kraft mill operation. The nature of kraft waste liquors and their effects on fish life have been studied comparatively little. Cole (*1*) investigated the effects of black liquor on fish and found that it was toxic in dilutions of 1 to 200 or more (5000 p.p.m.). He also found that methyl mercaptan was toxic in concentrations of 1 p.p.m. or higher. Bergström (*2*) and Bergström and Vallin (*3*) have studied the toxicity to fish of various components of kraft mill effluents, including digester condensates, diffuser liquors, etc. They found that the greatest poisonous action was shown by diffuser liquors and was caused by the resin acids and, to some extent, the fatty acids contained in these wastes.

These results substantiate those of Ebeling (*4*), who also stated that kraft wastes imparted a resinlike taste to fish life. Hagman (*5*) found that resin acids were poisonous to fish in concentrations higher than 1 p.p.m. and also that the sulphur components in the waste liquor were poisonous in relatively high concentrations.

Cole, in his reports of 1941 to the Kraft Waste Disposal Committee, stated that (1) black liquor in dilutions of 1 to 1000 is definitely toxic to carp; (2) black bass exposed for 68 days to a 1 to 3000 dilution of black liquor showed some symptoms of discomfort but were not permanently affected; and (3) 64 days of exposure did not impart any taste to the flesh of black bass. He also found that digester condensates were toxic in relatively high concentrations.

Extrom and Farner (*6*) concluded that (1) bass, blue gills, and sunfish thrived in "rivers" concentrations of black liquor, digester condensates, and mill "sewage." (2) Sewer concentrations of these waste liquors were toxic, and (3) it is possible for mill effluents to cause temporary toxic conditions in natural waters.

The inconclusive nature of the work cited above, together with the need for more specific information, impelled segments of the kraft pulping industry to conduct and support an investigation designed to clarify the entire relationship between the kraft mill and the stream. The work reported in this paper was originally started by the Kraft Committee on Waste Disposal of Wisconsin. Later the investigation was incorporated into the program of the National Council for Stream Improvement.

The objectives of the investigation may be listed as follows: first, to determine if, and to what extent, the waste liquors from a kraft mill are toxic to aquatic organisms; second, to devise methods for the detection and measurement of these potentially toxic components; and, third, to discover measures, in so far as possible, which would prevent these wastes from reaching the stream.

PROCEDURE AND RESULTS

Much has been written about the sensitivity of various species of fish to toxic conditions existing in their natural habitats. Some fish are quite resistant to environmental changes whereas others, especially some of the minnow family, are extremely sensitive. In this work, for the main part, the most sensitive forms of fresh water minnows were used. These included the following species: the spot fin shiner (*Notropis spilopterus*), the blunt nose minnow (*Hyborhyncus notatus*), the lake emerald shiner (*Notropis atherinoides*), and the rosy-faced shiner (*Notropis rubellus*).

In discussing this general problem with fishery biologists, the question is usually brought up as to the possible effects of a potentially toxic material on the fish food organisms, as well as upon the fish themselves. It is pointed out that, if a toxic material exerts a selective action upon fish food organisms to the point of their destruction, the effect will be essentially the same on the fish as if they were killed outright. Accordingly, the

Willis M. Van Horn, Research Associate, The Institute of Paper Chemistry, Appleton, Wis.
J. B. Anderson, Research Assistant, The Institute of Paper Chemistry, Appleton, Wis.
Max Katz, Technical Assistant, The Institute of Paper Chemistry, Appleton, Wis. (Now in the U. S. Public Health Service, Environmental Health Center, Cincinnati, Ohio).

present studies included examination of the possible toxic effect of kraft mill wastes upon representative species of the fish food organisms. Included in these was a typical Crustacean microorganism, *Daphnia*, as well as representative sensitive species of the larvae of aquatic insects; among these were the larvae of the May fly, the stone fly, the Dobson fly, and the midges.

Briefly, the procedure for conducting these tests was as follows: a 0.1% stock solution of the material to be tested was prepared by dissolving 1 gram of material in 1 liter of water. One milliliter of the stock solution in 1 liter of test water was considered to be a 1 p.p.m. test solution. Test solutions of other concentrations were made up accordingly. The water used in preparing the dilutions into which the fish were placed was a standardized water which was constant with respect to pH, alkalinity, and other pertinent characteristics.

When fish were used as test animals, the test aquaria were placed in a constant temperature water bath, the temperature of which could be adjusted from 11 to 20° C. From three to five fish were placed in each aquarium after the appropriate test solution was placed therein. The tests were run for a maximum of 120 hours and, if the fish survived at the end of this period, it was concluded that the concentration was below the minimum lethal concentration. In using *Daphnia* and the aquatic insect larvae as test animals, the procedure was essentially the same, except that smaller aquaria containers were used in testing.

In all cases, dissolved oxygen concentrations, pH, and alkalinity were taken before and after the test.

The first phase of this work consisted of a series of screening tests to determine which of the components of the typical kraft mill waste were more important in relation to the problem at hand. The results of these preliminary tests are shown in Table I. It will be noted that, of all the components of the kraft mill waste, sodium hydroxide, the sulphides, methyl mercaptan, and soap (or its constituents) constituted the greatest potential hazard to aquatic forms. It is apparent from these data that the other components

Table I. Minimum Lethal Concentrations of Kraft Pulp Mill Waste Components to Minnows

Compound	*Minimum lethal concentration, p.p.m.*
Sodium hydroxide	100.0
Sodium sulphide	3.0
Sodium sulphydrate	0.5
Methyl mercaptan	0.5
Hydrogen sulphide	1.0
Sodium thiosulphate	5.0
Formaldehyde	50.0
Sodium chloride	2500.0
Sodium carbonate	250.0
Sodium sulphate	100.0
Methyl alcohol	1000.0
Crude soap	5.0
Resin acid fraction of soap (sodium salt)	1.0
Fatty acid fraction of soap (sodium salt)	5.0

are of relatively little significance. For this reason, it seemed desirable to direct most of the attention of the study to these four classes of compounds.

Accordingly, more extensive tests were made upon fish, as well as upon *Daphnia* and certain species of insect larva. The data from these tests are contained in Table II.

Table II. The Minimum Lethal Concentrations of Kraft Pulp Mill Waste Components Affecting Minnows,[a] *Daphnia*, and Two Species of Aquatic Insect Larvae

Compound	*Minimum lethal concentration, p.p.m.*			
	Minnows	Daphnia	*May fly larvae*[b]	Chero-nomus *larvae*
Sodium hydroxide	100.0	100.0	100.0	700.0
Sodium sulphide	3.0	10.0	1.0	1000.0
Hydrogen sulphide	1.0	1.0	1.0	750.0
Methyl mercaptan	0.5	1.0	1.0	50.0
Crude soap	5.0	5.0	10.0	50.0
Sodium salt of resin acid fraction of soap	1.0	3.0	...	50.0
Sodium salt of fatty acid fraction of soap	5.0	1.0	...	...

[a] Spot fin shiner (*Notropis spilopterus*) and the lake emerald shiner (*Notropis atherinoides*).
[b] May fly larvae used were of the general *Blasturus* and *Leptophlebia*. No attempt was made to determine species.

In the opinion of many biologists, fish food organisms, representative species of which were used in these investigations, are more sensitive to toxic substances than are some of the higher vertebrate forms, such as fish. Logically, there is evidence to substantiate this opinion when the characteristics of the two types of forms are compared. It is assumed that these poisons find their way into the bodies of the animals, for the most part, through respiratory organs. The gills of *Daphnia* for example, are more exposed and more filamentous than those of the fish. This is also true of the aquatic insect larva. However, there is nothing in the evidence presented which will support the general theory that either *Daphnia* or the insect larva are more sensitive than the species of fish used. Generally speaking, therefore, it can be concluded that the minimum lethal concentration of the materials under consideration are much the same for the three general types of aquatic organisms investigated.

Once having determined which of the components of a typical kraft mill waste constituted the greatest potential hazard to the aquatic environment, the next step was the determination of the amounts of these materials in a kraft waste. To do this a number of methods were devised. Details of these methods are being reported elsewhere. Generally speaking, it can be stated that the methods adopted for the problem at hand consisted of potentiometric titration for the sulphide and mercaptans, a simple titration for alkali, and a modification of the Lieberman reaction for the soaps.

Using these methods, an extensive survey of the waste waters of five northern kraft mills was instituted. Much help was given by the personnel of these mills and a large number of analyses were made from June 1, 1947 to Jan. 20, 1948. Analyses were made for sulphides, mercaptans, resin soaps, and free alkali. Care was taken to sample under all phases of operating conditions and all the samples taken were grab samples. It should be noted that composite samples of these wastes will not show extremes in variation of chemical content. It has been demonstrated, for example, that, if a sample having a high pH is permitted to stand for an hour or so, its pH will gradually change in the direction of neutrality. For that reason, grab samples were taken to determine the extreme degree of

variation in the nature of the waste waters. At the time the samples were taken, data on the volume of sewer discharge, as well as the volume of river discharge, were also obtained.

Space does not permit the inclusion of all the data taken in this survey. However, Table III shows the data taken from a typical mill.

It will be noted from these data that, in 13 of the 35 analyses of the mill waste, the concentration of sulphides in the waste exceeded the minimum lethal concentration (1 p.p.m.); in all cases the concentrations of mercaptan exceeded the minimum lethal concentration (0.5 p.p.m.); in all cases the content of the resin acid soap exceeded the minimum lethal concentration (1 p.p.m.); and, in four of the 35 analyses the concentration of sodium hydroxide exceeded the minimum lethal concentration (100 p.p.m.). As soon as the wastes were discharged, however, dilution with river water takes place at varying rates depending upon the volume and velocity of river flow. The lowest dilution ratio observed at this particular mill was 1 to 94 as indicated in Table III. If total dilution is assumed, the concentrations of the toxic materials would be held to a point below the minimum lethal concentration as soon as the necessary dilution had occurred. In the entire study, including phases not presented here, the lowest ratio of dilution found in the receiving streams was 1 to 73. Similarly, the highest concentrations of the compounds under study were: sulphides, 88.4 p.p.m.; mercaptans, 45 p.p.m.; resin soaps, 48 p.p.m.; and sodium hydroxide, 3763 p.p.m. Although these conditions did not appear simultaneously, they do form a theoretical picture of what could happen under the worst conditions. In each case, however, the concentrations of the materials after dilution were brought to a point where the danger is reduced to a minimum, if not eliminated.

Table III. The Results of Waste Water Analyses of a Typical Northern Kraft Mill from June 24 to Sept. 12, 1947

Sample No.	River dilution ratio[a]	Parts per million: Sulphides	Mercaptans	Resin soaps	Sodium hydroxide	pH
1	170	0.7	1.5	5.0	6.6	8.6
2	166	0.6	0.7	5.0	8.0	8.8
3	178	1.5	4.1	18.0	61.4	9.9
4	218	1.6	1.8	8.0	24.2	9.4
5	185	1.0	1.2	5.0	12.0	9.0
6	193	0.2	1.9	5.0	0.0	7.8
7	275	18.4	12.0	18.0	114.0	10.6
8	232	0.5	2.5	3.0	6.6	8.7
9	224	0.2	0.7	3.0	0.0	8.2
10	138	0.4	0.9	2.0	0.0	8.2
11	142	0.9	1.6	3.0	0.0	8.2
12	126	0.0	1.0	3.0	0.0	8.1
13	123	0.8	1.6	3.0	14.7	8.7
14	193	0.0	2.7	5.0	10.6	8.7
15	173	0.2	1.4	5.0	0.0	8.3
16	191	0.2	0.9	5.0	14.7	8.8
17	173	0.2	1.2	2.0	0.0	7.6
18	176	0.0	1.1	5.0	0.0	7.9
19	166	0.0	1.2	3.0	0.0	7.9
20	177	0.2	1.1	3.0	0.0	7.7
21	153	0.2	1.1	3.0	0.0	8.4
22	152	0.0	0.8	3.0	0.0	8.1
23	157	0.0	0.6	2.0	0.0	8.3
24	144	0.3	1.0	2.0	2.6	8.5
25	156	2.1	1.9	3.0	13.3	8.9
26	161	88.4	15.8	18.0	391.0	10.5
27	113	0.4	1.6	3.0	4.0	8.5
28	103	0.3	1.7	3.0	17.3	9.0
29	96	0.0	3.1	5.1	9.3	8.7
30	94	2.8	3.3	8.0	21.4	8.8
31	94	25.8	8.1	18.0	115.0	9.4
32	134	0.4	1.0	3.0	144.0	10.7
33	136	3.6	5.1	5.0	13.7	8.9
34	127	2.8	7.2	3.0	9.4	8.8
35	109	1.3	0.9	5.0	0.2	8.5

[a] The river dilution ratio is calculated by dividing the volume of river discharge by the volume of sewer discharge.

DISCUSSION

The primary purpose of this investigation was to determine whether or not a problem relating to fish toxicity is associated with the normal operation of a kraft pulp mill and, if there is a problem, to determine its seriousness.

It is desirable to clarify the meaning of toxicity. Almost any chemical or other material may become toxic if it is present in sufficient amounts. For example, human beings require certain amounts of sodium chloride for their normal metabolic processes. If they are deprived of this chemical for a sufficient period, they cannot live. On the other hand, if sodium chloride is ingested in too great amounts, the point is reached when the body can no longer assimilate such excess and death may result. It is clear then that, when reference is made to a toxic substance, such reference implies that such a substance must be present in the environment in amounts sufficient to cause abnormal metabolism and result eventually in death. In this paper, the smallest amount which caused death is referred to as the minimum lethal concentration.

In the mill sewer survey referred to above, it was apparent that the majority of the analyses indicated that concentrations of the materials under investigation existed in the sewers in excess of their minimum lethal concentration. In most cases, however, it was calculated that, when total dilution of the sewer contents had taken place in the receiving stream, the river concentration of the potentially toxic substances was far below the minimum lethal concentration.

The term "assuming total dilution" has been used frequently in this report and its significance has important implications in the problem. Obviously, sewer contents will eventually reach a point of total dilution in all the streams under investigation. The crux of the problem, however, is the speed with which total dilution is effected after the waste waters pass to the stream. This speed, of course, depends upon a number of factors, all of which are variable.

One point must be considered in relation to this problem. The data show that, in the majority of cases, the concentration of the potentially toxic materials in the sewer exceeded the minimum lethal concentrations to fish and other aquatic forms. This does not mean, however, that fish and other forms coming in contact with these waters would be killed instantly. In many of the analyses, the data showed that the amounts were near or only slightly higher than the minimum lethal concentration. Laboratory experiments on toxicity behavior have shown that fish often exist for extended periods in such concentrations before exhibiting the symptoms of impending death. It is possible, therefore, that, in many of the cases described above, before the fish in the receiving stream would be adversely affected, adequate dilution would have taken place or the fish would have moved out of the zone of danger.

Another point of interest is the considerable variation that takes place in the strength of these wastes. Pre-

vious experience has shown that, upon standing, the sulphides and the mercaptans in kraft mill wastes lose these toxic properties. For that reason all the samples were grab samples and were analyzed immediately after being taken. In one mill, the period between samplings ranged from 2 minutes to several hours. It was noted that the concentration of the wastes under study may vary by as much as a factor of three during a period as short as 10 minutes.

There are several points of interest in this work which arise from arrangements peculiar to the individual mills. For example, in one mill, it was possible to correlate the concentration of the potentially toxic materials with the activity in the digester house. More specifically, the data indicate that (in this mill, at least), the concentrations of sulphides and other compounds were higher in the sewer when a digester was blowing than when there was no blowing.

On the basis of the data presented herewith, it can be stated that, if dilution of the effluent is rapid and thorough enough, the danger to fish will be reduced to a minimum, if not rendered nonexistent.

LITERATURE CITED

1. Cole, Arch E., *Sewage Works J.* 7: 280–302 (1935).
2. Bergström, Hilding, *Svensk Papperstidn.* 42: 223–289 (1939).
3. Bergström, Hilding, and Vallin, Sten., "The Contamination of Water by the Waste Liquors of Sulphate Pulp Mills." Medd. Statens Andersöken-Försöksants Satvattenfisket, Kgl. Lantsbruksstyrelson No. 13, 1937. 17 p.
4. Ebeling, G., *Vom Wasser* 5: 192–200 (1931).
5. Hagman, Nils., *Finnish Paper Timber J.* 18: 32–34, 36–38 (1936).
6. Extrom, J. A., and Farner, D. S., *Paper Trade J.* 117, No. 5: 27–32 (July 29, 1943).

Received March 3, 1950. Presented at the Annual Meeting of the Technical Association of the Pulp & Paper Industry, New York, N. Y., Feb. 20–23, 1950.

This paper is based on a cooperative study between the National Council for Stream Improvement, five Wisconsin kraft mills, and The Institute of Paper Chemistry. Appreciation is expressed to Harry Gehm of the National Council for Stream Improvement, M. L. Downs of Thilmany Pulp and Paper Co., R. A. Nugent, and T. A. Pascoe of the Nekoosa-Edwards Paper Co., Carl Moe of the Stevens Point Pulp and Paper Division of the John Strange Paper Co., Gust Enderlein of Mosinee Paper Mills Co., and Kermit Olson of the National Container Corp. of Wisconsin.

Casein Adhesives in Roll Coating

J. WILSON SMITH, RICHARD T. TRELFA, and HARRIS O. WARE

High-quality coated paper, normally associated with casein adhesives, can be easily prepared on roll-coating equipment. Satisfactory techniques for applying casein colors to paper on this type of equipment were first developed in the laboratory, and subsequent experience has proved that these procedures are adaptable to commercial machines. The laboratory phase of this development was performed with an experimental machine coating unit and the Hercules Hi-Shear Viscometer. Using this equipment it was found that the flow properties of most colors governed their operability on the machine. Unmodified casein colors have high viscosity and pronounced dilatant tendencies, precluding production of acceptable coatings. These properties can be corrected by incorporating proper rheology-modifying agents, such as sodium sesquisilicate, into the color. With the sesquisilicate modification, some colors have satisfactory operating characteristics up to 65% solids. Two mixing procedures are recommended. In one, dry casein is added to a pigment slip and solubilized in the presence of the pigment. In the other, a casein solution is prepared first, and then the dry pigment is added to the solution. Either process can be used with sigma-blade mixers, but only the latter is recommended with paddle-agitated mixing tanks. Paper from casein colors modified with sesquisilicate can be hardened by treating with formaldehyde solution or vapor. The rheological procedures of value in predicting the operability of a color comprise (1) a characterization of the type of flow exhibited by the color, (2) a numerical estimate of its thixotropy, and (3) a determination of its viscosity at a high rate of shear. From these data indices are obtained which have correlated with the intensity of surface pattern on the coated paper. A possible rheological mechanism of patterning is also presented.

High-quality coated paper, with casein as the adhesive, has been produced on relatively low-speed brush and air-knife coaters. Recently, techniques have been developed by which casein-formulated coating mixes at high total solids can be applied by roll coaters.

In the publication grades the speed and efficiency of the roll-coating process has expanded the market for coated paper. The grades of paper which could be produced, however, were usually limited to those for which starch was a satisfactory adhesive.

Two main difficulties have been reported when casein has been incorporated in coating mixes for roll application: (1) transfer of the color from the applicator roll to the paper was not complete. Not only was the transfer itself uneven, but frequently there was a gradual accumulation of color on the face of the applicator roll. (2) The residual surface pattern left on the paper when the coating stripped from the applicator roll was generally too intense.

In order to study the factors influencing these difficulties, an experimental machine coater was designed and constructed. This machine, shown in Fig. 1, has provisions for varying the speed of paper travel from 125 to 750 f.p.m. The color train consists of four adjustable 12-inch diameter by 13-inch face rubber-covered rolls to meter and distribute the color and apply it to paper, and a chrome-plated backing roll. The coating weight applied at a given nip clearance is governed by a variable speed ratio between the metering rolls and the applicator roll. The paper feeds into the coating unit from an unwind reel stand and tensiometer. The time of contact between the coating mix and the paper before entering the nip can be varied by regulating the angle at which the paper enters the coating nip. Three drying drums and a rewind stand complete the equipment.

A viscometer was developed to analyze the flow properties of coating mixes at rates of shear sufficiently

J. Wilson Smith, Hercules Experiment Station, Hercules Powder Co., Wilmington, Del.
Richard T. Trelfa, Hercules Powder Co., Kalamazoo, Mich.
Harris O. Ware, Hercules Powder Co., Wilmington, Del.

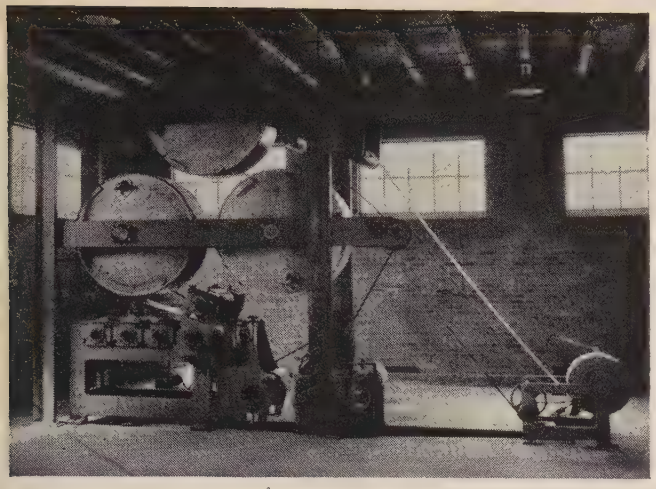


Fig. 1. Experimental machine coater (shown without guards or mezzanine)

high to be well above the levels at which radical alterations of the rheological properties occur. The data reported in this study have been obtained on a viscometer modified from the original instrument as described in a previous paper (*1*). The modified viscometer is shown in Fig. 2.

Measurements of coating-color rheological properties on the Hi-Shear Viscometer have been correlated with experimental transfer and patterning data from the laboratory coater and commercial mill coaters.

To avoid confusion, a brief definition of the rheological terminology used in this paper follows (see Fig. 3).

There are four basic patterns of flow: Newtonian, plastic, pseudoplastic, and dilatant. In rheograms, or torque vs. rate of shear curves, Newtonian materials yield straight lines intercepting the origin, while plastics have a yield stress and the straight line intercepts the torque axis. Pseudoplastics and dilatant materials yield curves which intercept at the origin. Pseudoplastics show disproportionally small torque increases with increasing rate of shear. Dilatancy produces the reverse effect. All except Newtonian flow can coexist in the same system. Thixotropy, a gel structure with a time lag required for its reformation after breaking,

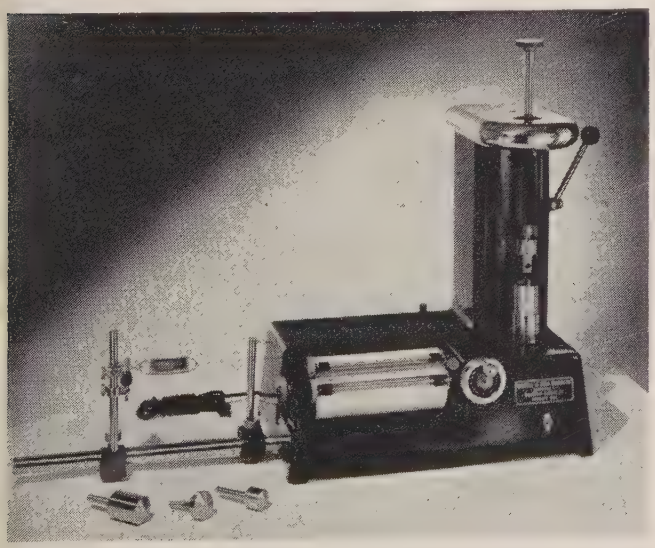


Fig. 2. Hercules Hi-shear Viscometer (commercial model)

manifests itself by hysteresis in the rheogram. It can be superimposed on any of the basic types of flow, including "Newtonian." This nomenclature has been more extensively defined in a previous paper (*1*).

RHEOLOGICAL MODIFICATION OF CASEIN COLORS

It is well known that ordinary casein colors above 55% total solids do not give pattern-free surfaces in normal coating-weight ranges when applied by roll coaters. Trial and error techniques resulted in starch-formulated coating mixes which were pattern-free. The same trial and error technique did not produce operable casein coating mixes. Rheological examination of casein and starch coating mixes revealed distinguishing characteristics. The casein coating mixes which patterned were characterized as plastics having a tendency toward dilatancy, a small amount of thixotropy, and a relatively high viscosity. The starch-coating mixes which did not pattern were characterized as plastics having a significant amount of thixotropy and a relatively low viscosity.

Casein colors must be rheologically modified before

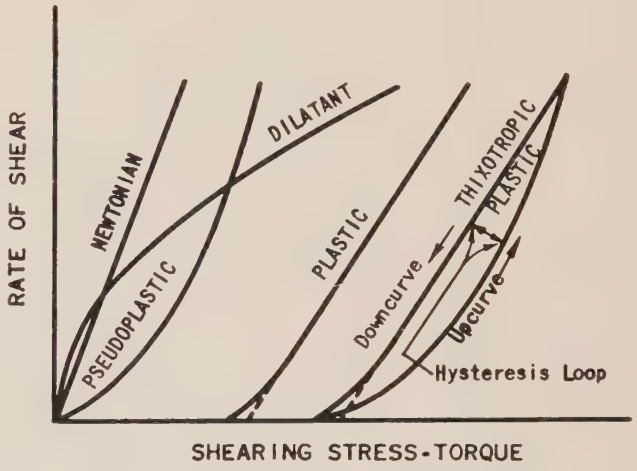


Fig. 3. Types of flow determined on a rotational viscometer

they can be expected to operate satisfactorily on the machine because they have insufficient thixotropy at high viscosity to give pattern-free surfaces. If the casein is cut with one of the normal solubilizing agents and the solids of the colors are increased above about 58%, dilatancy is encountered, and the patterning tendency is accentuated.

With starch colors, the amount of thixotropy contained in the system can be varied over wide limits by reacting the starch with soap to form the well-known soap-starch-pigment gel. Although soap does not give acceptable rheological modification of casein colors, other agents do. Typical rheograms of rheologically modified casein coating colors are shown in Figs. 4 and 5.

At low rates of shear the up-curve rheograms of these colors often show an apparent dilatant effect. This effect is caused by competing components in the system and is not true dilatancy. The phenomenon disappears at higher rates of shear.

The coating colors represented by the above rheograms were modified with sodium sesquisilicate. The

choice of this reagent was the result of a screening analysis of more than 450 different surface-active agents. Rheological modifications accomplished with sodium sesquisilicate were sufficiently marked to merit further experimentation in the testing of our premise that suitably rheologically modified casein solutions would produce pattern-free paper on roll coaters, although it is known that sodium sesquisilicate is not unique in its rheological effect. With the proper amount of sesquisilicate, the apparent viscosity may be reduced to less than 30% of that of the unmodified color. In addition, the solids content at which dilatancy occurs can be increased from about 58% to more than 65% with a normal pigment furnish. Colors modified with sesquisilicate are normally pseudoplastic and, therefore, require little thixotropy for acceptable performance. The amount of thixotropy exhibited can be controlled by varying the fine-fraction clay content of the pigment furnish.

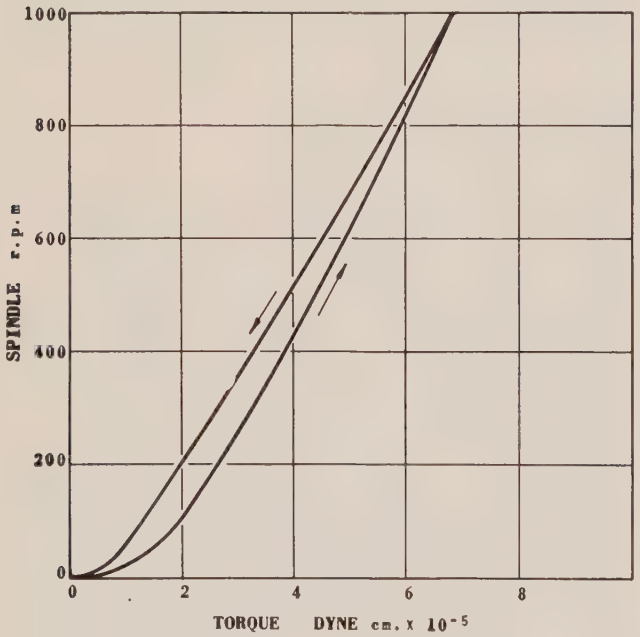


Fig. 4. Rheogram of typical operable casein machine coating mix

The relationship between apparent viscosity and amount of sodium sesquisilicate is shown in Fig. 6. A typical formulation which will produce rheograms of the type shown in Fig. 4 will contain clay, casein, sodium hydroxide, sodium sesquisilicate, and water in the following proportions:

Rheologically Modified Casein Coating Mix

	Parts
Casein	12.5
Clay	100.
Caustic soda	0.5
Sodium sesquisilicate	1.25
Water	74.
Total	188.25

PREPARATION OF HIGH-SOLIDS CASEIN COLORS

The normal procedure for preparing casein colors for low-solids coating is inadequate in producing colors of over 50% total solids. Difficulty is encountered in preparing pigment slips and casein solutions at high

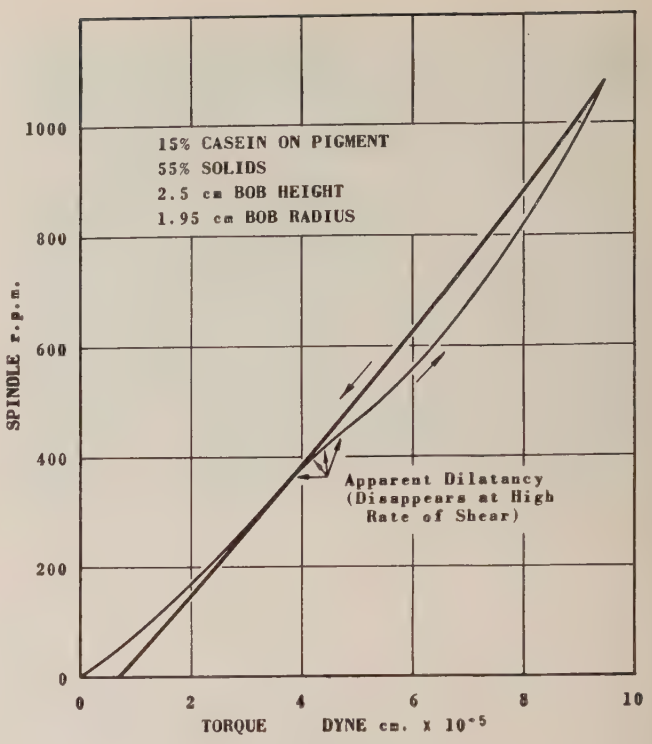


Fig. 5. Rheogram of typical operable casein machine coating mix

enough concentrations for the final color to have the desired low water content, and when the high-solids pigment slip is mixed with a concentrated casein solution, there is a marked tendency for the pigment to agglomerate.

There are two methods of mixing high-solids colors which are superior to the low-solids procedure. The first of these two processes utilizes a previously prepared casein solution. This process has the advantage of a somewhat shorter over-all time cycle in the mixers and lower power consumption for each batch but has a limitation in the amount of casein which can be incorporated into the color. The other process, in which

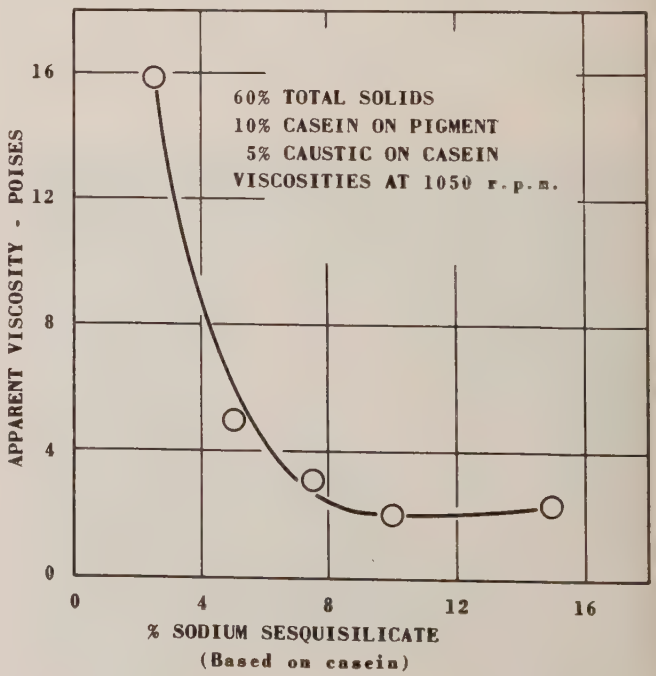


Fig. 6. Effect of sodium sesquisilicate on apparent viscosity of high-solids casein coating color

casein is solubilized in the presence of the pigments, is not limited in casein-to-pigment ratio.

In the process utilizing a prepared casein solution, the casein is dissolved at 25 to 30% concentration by dispersing it with 3 to 5% NaOH (based on the casein) at 110 to 125°F. for 20 to 30 minutes. Other alkalies are not recommended because they tend to increase viscosity. The casein solution is then charged into the mixer and the pigment is added either in dry form, as a high-solids slip, or as a combination of both. The solids content at this stage is preferably 70% or more after all the pigments have been added. A lower solids content may result in inefficient dispersion, but the proper maximum solids content will depend on the mixing equipment and composition of the mix. There is apparently no limitation on the type of pigment which can be used.

When the color is uniformly and thoroughly dispersed, dilution water is slowly added.

The second of the two procedures involves adding dry casein to a prepared dispersion of pigments. The pigment slips plus the alkali solution for dispersing the casein can be adjusted to contain all of the water required to attain the maximum mixing solids, and the alkali solution can be added to the slip either before or immediately after the casein is charged into the mixer.

The effectiveness of the modifier may be influenced by its order of addition relative to the other components; e.g., sodium sesquisilicate is more effective when added to the otherwise completed coating color. In this specific case it is desirable to withhold some of the dilution water so that the sodium sesquisilicate may be added in solution form.

In general, equipment capable of preparing satisfactory starch-base high-solids colors is also capable of preparing satisfactory high-solids casein colors.

OPERABILITY CHARACTERISTICS OF CASEIN COLORS

Casein colors prepared by these two processes will usually show identical operating characteristics on the coating machine. The total solids will be 2 to 7% below the level commonly employed for starch to give the same coating weight without altering the machine conditions. Operable high-solids casein colors can be manipulated to give a wide range of coating weights free from pattern. The maximum coating weight which can be applied without pattern is a function of the rheological properties of the coating mix; e.g., on the experimental coater a given machine setting which produces a satisfactory 14-pound coating at 62% coating color solids will produce a satisfactory 4-pound coating at 52% solids.

In order to obtain the unusual water resistance potentially available in casein-bound coatings, the casein must be insolubilized with additional reagents. Part of this water resistance can be attained by including satin white in the formulation. Incorporation of other cationic electrolytes as well as aldehydes and their progenitors in the coating mix is undesirable because of the rapidity with which they react and their effect upon the rheological properties. In many cases it may be desirable to treat the coated-paper surface with a dilute solution of formaldehyde or with formaldehyde vapor. One method is to atomize a formaldehyde solution into the steam supplied to the supercalender steam showers. Alternative methods consist in applying a dilute formaldehyde solution by roll or spray or by passing the paper over a formaldehyde vapor box. Excellent water resistance is obtained in each case. If a lower residual alkali content in the coating is desired, acid may be included in the formaldehyde solution. Calendering these papers presents no problem.

Casein adhesives maintain their brightness and strength advantages over starch in high-solids coating in about the same ratio as in low-solids coating, and these high-solids procedures have already found commercial acceptance. Four-color offset printing has been performed without difficulty on casein-bound roll-coated paper. The mixing techniques for preparing high-solids casein colors have been used commercially, and neither involves operating difficulties when properly controlled.

RHEOLOGY IN ROLL COATING

The experimental evidence collected in the comparative evaluation of starch- and casein-formulated coating mixes has emphasized the rheological approach to an understanding of paper-coating mechanism. From an extension of a classification of rheological phenomena, as defined by Green and Weltmann (*3*, *4*, *5*), a ranking of the patterning tendency of coating mixes has been reduced to a numerical value called "leveling index" for thixotropic "Newtonians" and plastics. Other considerations have led to the development of a similar index which has practical applications for pseudoplastics. When consideration is given to these indices and the mechanism of shear in the coating roll train, an explanation can be derived which seems to account for the experimental observations made about the uniformity of coatings applied on roll coaters. These subjects are discussed in some detail in the hope they may contribute a constructive item to paper-coating technology.

In general, the rheological properties of coating colors govern the weight and surface pattern relationships which result when the color is applied on the coating machine. With a satisfactory mechanical adjustment of the machine, a rheologically operable coating formulation gives definite, characteristic weight-pattern relationships. At very light coating weights there may be insufficient coating applied to cover the paper, and the surface of the paper will be striped with parallel bands of coating. Above the point where the paper is covered lies a range of coating weights with relative freedom from pattern; the more versatile the color, the wider is the pattern-free range. At the upper limit of this range the paper surface becomes roughened or grained, and further increases result in a moiré or stipple pattern sometimes referred to as "orange peel."

With rheologically inoperable colors, there is no pattern-free range. In some cases the tops of the ridges on a striped pattern may have heavy moiré. The flow properties of a color seem to control the existence and extent of the range of coating weights free from pattern. To be significant, though, the flow properties must be measured at rates of shear above the point at which radical changes in fluid behavior occur.

"Newtonian," pseudoplastic, and plastic materials have not been made to operate with satisfactory free-

dom from surface pattern at any coating weight on the machine coater unless considerable thixotropy was also exhibited. In addition, any detectable dilatancy apparently precludes freedom from pattern, no matter how great the thixotropic effect. Pseudoplastics, however, require much less thixotropy for acceptable performance than "Newtonians" and plastics.

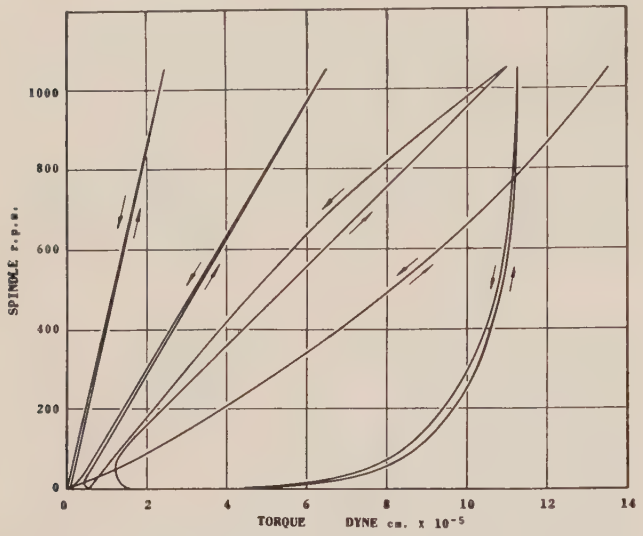


Fig. 7. Rheograms of typical inoperable machine-coating colors

Figure 7 shows a collection of typical rheograms taken with the Hercules Hi-Shear Viscometer of coating mixes that yielded no pattern-free paper under any set of machine conditions on the experimental coater. Figure 8 shows typical rheograms of operable formulations. The amount of thixotropy at constant viscosity level required to insure satisfactory operability characteristics probably varies only slightly with different coating machines.

Leveling Index

During the early phases of correlating the flow properties of the color with its patterning tendency on the machine, it was readily apparent from a visual inspection of the rheograms that the hysteresis (or thixotropic effect) was the dominant factor in eliminating surface pattern on the coater.

The first attempt to determine the influence of thixotropy quantitatively was a direct comparison of the Green and Weltmann (*4*) coefficient of shear thixotropy with patterning. This coefficient is a number which is a measure of the tendency of a material to break down under increasing rates of shear. More specifically it is the loss in viscosity resulting from a definite increase in rate of shear. It has the advantage of being a constant for a given material and, within limits, independent of the conditions of measurement. The attempted correlation of this coefficient with patterning tendency was unsatisfactory, chiefly because a given operable coating mix would generally remain operable at all solids contents below the dilatant level, while the values of the coefficient would increase from very small to very large as the solids increased.

It was observed that an increase of solids, however, also increased the plastic viscosity of the material and apparently at about the same rate as the coefficient increased. The ratio of the coefficient to the plastic viscosity was then found to be substantially constant. This dimensionless ratio we have called the "leveling index," and it is the most practical measure of the patterning tendency of a color of which we are aware. The index I can be easily determined for thixotropic "Newtonians" and plastics from the following equations:

$$I = M/U_2$$

where M is the coefficient of shear thixotropy and U is the plastic viscosity

$$M = (U_1 - U_2)/\ln (\text{r.p.m.}_2/\text{r.p.m.}_1)$$
$$U = 9.55\,(T - T_2)\,S/\text{r.p.m.}$$

where T is the torque at the selected revolution per minute and T_2 is the extrapolated torque intercept of the down curve. U_1 and U_2 are plastic viscosities at two different revolution-per-minute levels. The instrument constant S is

$$S = (1/R_b^2 - 1/R_c^2)/4\pi h$$

where R_b and R_c are the bob and cup radii and h is the bob height.

U_2 is an arbitrarily selected plastic viscosity measured at a rate of shear above the level at which radical alterations of the character of a rheogram become apparent; this is in the range of 4000 to 5000 reciprocal seconds. The values for use in the above equation should be obtained under constant conditions of rate of change of rate of shear for the up curve.

Normally, I does not change with altered color solids and, therefore, probably represents the amount of thixotropy per unit of plastic viscosity inherent in the coating formulation. One determination of I, under testing conditions of 30 seconds for the up curve of the rheogram and 10 seconds for the down curve, usually

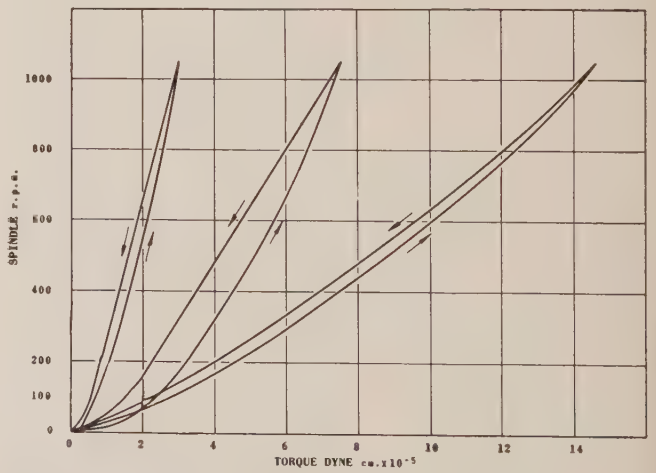


Fig. 8. Rheograms of typical operable machine coating colors

predicts the operability of the formulation at all solids contents below the dilatant level. When determined by this procedure, values of I below 0.2 to 0.25 indicate inoperability; 0.2 to 0.35 is the borderline region, and above about 0.35 operability is expected. As so far encountered, the higher the index the greater is the versatility of the color, although it is probable that an

upper limit does exist. Ratios above 1.0 have not been investigated.

Unfortunately, there is at present no comparable index for pseudoplastics. From experience obtained to date, however, it can be tentatively concluded that the same general factors affect the operability of pseudoplastics. In all experimental and commercial runs encountered, an increase in the ratio of hysteresis loop area of a thixotropic pseudoplastic to apparent viscosity at peak rate of shear has resulted in a more versatile coating color. Pseudoplastics with low ratios are inoperable.

The plasticity index, b, in the equation:

$$\text{Log } \eta = a - b \log (\text{rate of shear})$$

has been used with moderate success to evaluate pseudoplastics, even though at the present time it does not have a theoretical basis and tells nothing about the thixotropy of the system. η, of course, is the apparent viscosity on the up curve of the rheograms and equals 9.55 TS/r.p.m.; the rate of shear is $\omega/2\pi R^2 hS$ or $2\omega/R_2(1/R_b^2 - 1/R_c^2)$, where ω is the angular velocity or r.p.m./9.55, T is the torque, and S is the instrument constant.

If the leveling index and total solids of the color are both known, and if the necessary machine correlation has been established, the rheological pattern characteristics of any coating-weight range can be predicted.

Theoretical Treatment of Roll Shear Conditions

Based on the concept of a uniform, symmetrical velocity gradient across the roll nip, the approximate rate of shear developed can be considered to be of the order of 10^4 to 10^6 reciprocal seconds. Color circulating in the nip of these rolls (see Fig. 9) obtains a downward vector from the roll motion, and the portion nearer the roll faces begins to move toward the nip. The volume contained between the roll faces decreases as the nip is approached and, since the liquid is substantially incompressible, pressure is developed. The portion of the color farthest from the rolls reverses itself and moves upward. Somewhere on a vertical line halfway between the roll faces, there must be a point at which the coating is substantially stationary. Vertically above this point, color is moving upward; below it everything is moving downward through the nip and out of the other side.

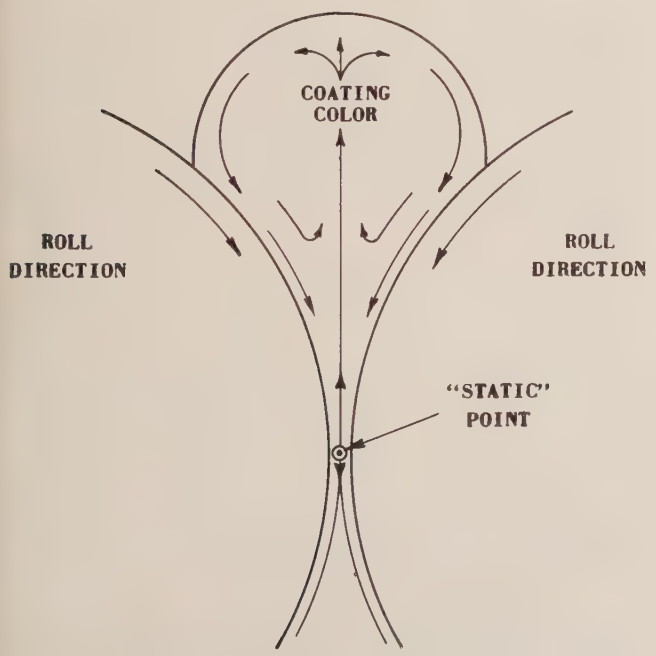


Fig. 9. Schematic diagram of color circulation in a roll nip

At and immediately below this point, the color must flow in a manner analogous to flow through a capillary.

If there were no change of rate of shear across half of the roll gap, the rate of shear would be easily estimated in the following way:

If the roll clearance was 0.0005 inch and the peripheral speed 500 f.p.m., the rate of shear would be:

$$500 \times (12/60)/0.00025 = 400{,}000 \text{ reciprocal seconds}$$

It is more probable, however, that the rate of shear is zero at the static point and maximum at the roll face. The complications in calculating a reliable estimate are demonstrated by consideration of a flow analysis in a nip of incompressible rolls rotating at the same speed. The driving or activating force F then would be:

$$F = 2\,dlp$$

where d is the distance from the static point toward the roll along a line normal to the roll face, l is the lateral length of the rolls, and p is the induced hydraulic pressure per unit area. The resisting force F' must be equal and opposite to F since the velocity gradient within the fluid is constant at any given distance d.

$$F' = 2\eta lh(dv/d(d))$$

where η is the viscosity, h is the vertical height over which the flow pattern exists, and $dv/d(d)$ is the rate of shear.

Then:

$$2\eta lh(dv/d(d)) = 2dlp$$

$$dv/d(d) = (p/\eta h)d$$

Simply stated, the rate of shear is directly proportional to the distance from the static point and is a maximum at the face of the roll, and this hypothesis can be extended to cover rubber rolls merely by assuming that a deformed and extended capillary is produced by their compression. With pseudoplastics and thixotropic materials, moreover, η decreases with an increasing rate of shear.

Continuity equations developed by Frazer (*6*) indicate that the central portion of the color, after the static point is passed, is accelerated by this pressure to a velocity greater than that of the roll periphery. In the case of incompressible rolls of equal radii, the same peripheral velocity, and reverse directions of rotation, the maximum velocity is three halves that of roll surfaces. It is logically almost certain from either consideration alone or both together that the material closest to the roll surfaces is subjected to higher rates of shear than is the segment in the center.

Hypothetical Mechanism of Patterning

The original hypothesis developed to explain the superior nonpatterning performance of thixotropic materials was analogous to the well-known after-leveling of thixotropic paints. This hypothesis is not now considered a major factor in elimination of residual pattern because of the limited time available for leveling

before the absorption of water sets the coating and prevents further flow. Furthermore, after-leveling has not been verified experimentally. A more complex theory is required and may be described as follows:

When paper is introduced into a nip containing coating color, the paper immediately begins to absorb water from the color. The flow pattern is consequently distorted, but the time of contact between the paper and the color in the nip is short and the loss of water is probably greatest in the segment of color adjacent to the paper.

Another factor must now be introduced. Henry Green (*2*, *7*) has shown that the relative tack of a material (compared to a standard) is proportional to its plastic viscosity if the application is made at high speeds. By tack, he implies pull resistance or resistance to rupture. Also, the tendency to form necks, and the length and diameter of the necks, are obviously involved and will increase with the plastic viscosity. With thixotropic "Newtonian," thixotropic plastic, thixotropic pseudoplastic, or pseudoplastic materials, viscosity is least where the rate of shear is greatest, and this point occurs close to the face of the roll; therefore, resistance to rupture is also least at that point.

It has been observed that as the color leaves metering and distributing nips, where no absorbent surface is present, it is drawn out into threads before rupturing. Superficially, it would seem that this effect is in contradiction to that anticipated from the theoretical analysis just described. Actually, it is entirely in accord with the theory. "Necking down" involves lateral flow of the color along the roll face prior to the creation of the two new air-color interfaces because the work of creating the new surfaces is additive to the work involved in overcoming flow resistance. The film must, therefore, flow as long as possible in preference to rupturing. The lateral flow supplies an additional quantity of the material so that "necking down" can proceed, and as it begins, stress concentration develops. The highest rate of shear is then transferred from the face of the roll to the center of the film. This stress concentration causes films of any materials that are not dilatant to rupture in the center rather than at the face of the roll.

When paper is present in the nip, its absorption of water in effect solidifies a layer of coating to the paper so that lateral flow cannot proceed and stress concentration cannot develop so readily. Cleavage of films of thixotropic or pseudoplastic materials then proceeds at or close to the roll face. The patterning tendency of these materials on paper, therefore, is expected to be slight for thin films.

In the case of Newtonian and nonthixotropic plastics the situation is different. With the exception of the region in contact with the paper, the film possesses the same viscosity throughout its thickness, regardless of shearing conditions. There is no point of minimum viscosity or relative tack, hence no point of preferential rupture. The film may break at any point, the average height and diameter of the "necks" are larger, and the resulting surface pattern is heavier. With dilatant materials the sequence is reversed. With paper in the nip, the preferred cleavage point might be in the center of the film where the rate of shear is lowest, and the pattern might be even heavier. In addition a deposit might slowly form on the applicator roll, although this formation is not inevitable because dilatant effects are instantly reversible. Other behaviors, resembling dilatancy except for instantaneous reversion, may inevitably cause accumulation.

Regardless of where rupture occurs, it is almost certain that some "necking down" results. Pseudoplastics require less thixotropy than plastics to yield pattern-free paper according to this theory because a portion of the viscosity decline required to produce the point of preferential cleavage at the roll face would result from the pseudoplasticity itself, despite the change in direction of flow at break. Practice has confirmed this expectation.

Andries Voet (*8*) has presented evidence that the high-speed rupture of these films occurs by a mechanism of nonequilibrium elasticity. According to this theory, the thixotropic or pseudoplastic breakdown in the roll nip might be even more important than the straight proportionality indicated by Green (*2*, *7*).

In the present paper the authors have attempted to summarize a new concept with the related experimental procedure and evidence, which led to the successful application of casein colors to machine coating. Casein is now being used in commercial roll coating without major difficulty.

The experimental rheological results can be stated very simply. The leveling index, and to a lesser extent the plasticity, offer convenient, reliable numbers for ranking the patterning tendency of a color. This number, the type of flow on which it is based, and the total solids are generally all that need be known in predicting the operability of coating colors. If a coating color has a solids content high enough to permit drying and low enough to avoid dilatant effects, the amount of shear thixotropy per unit viscosity, measured at greater than 4000 reciprocal seconds of shear, is a direct measure of its patterning tendency. Insofar as present studies have gone, inspection of the rheograms indicates that the patterning tendency of the color continues to decrease as this ratio increases regardless of whether the color is pseudoplastic or plastic. For pseudoplastics the ratio cannot be so conveniently calculated, but it is fairly definite that pseudoplastics require less thixotropy for operability than plastics.

The rheological conclusions seem to hold regardless of the type of pigment or adhesive employed in preparing the color.

LITERATURE CITED

1. Smith, J. W., and Applegate, P. D., *Paper Trade J.* 126, No. 23 60–66 (June 3, 1948); *Tech. Assoc. Papers* 31: 208–214 (1948).
2. Green, H., *Ind. Eng. Chem., Anal. Ed.* 13: 632 (1941).
3. Green, H., *Ind. Eng. Chem., Anal. Ed.* 14: 576 (1942).
4. Green, H., and Weltmann, R. N., *Ind. Eng. Chem., Anal. Ed.* 15: 201 (1943).
5. Weltmann, R. N., *Ind. Eng. Chem., Anal. Ed.* 15: 424 (1943).
6. Frazer, R. A., *Trans. Roy. Soc.* (London) A225: 93–130 (1925).
7. Green, H., "Applied Rheology and Rheological Structures," John Wiley and Sons, N. Y. (1949).
8. Voet, A., paper presented before November, 1949 meeting of Society of Rheology, as yet unpublished.

Received Feb. 20, 1950. Presented at the Annual Meeting of the Technical Association of the Pulp & Paper Industry, New York, N. Y., Feb. 20–23 1950.

Effect of Phenolic Resins on Physical Properties of Kraft Paper

PARKER K. BAIRD, ROBERT J. SEIDL, and DONALD J. FAHEY

The physical properties of phenolic-resin-treated kraft paper were determined to note the effects of various amounts and types of resins and thicknesses of paper on the tensile strengths in the dry and wet conditions, and on air resistance, stretch, density, dimensional swelling, equilibrium moisture content, and water-vapor-transmission rate. Impregnation of the paper with a water-soluble phenolic resin increased the thickness of the paper appreciably above the original thickness of the paper. This also caused a greater percentage increase in the tensile strength in the dry condition in the cross than in the machine direction. In most cases, the strength of the treated paper in the wet condition, equivalent to prolonged exposure to high humidities, was greater than the strength of the untreated paper in the dry condition. Paper with about 15% resin retained, after soaking, at least 80% of its tensile strength when dry. The dimensional swelling of the untreated and of the treated 9-mil paper in the cross-machine direction was more than twice that in the machine direction. A paper with 14% of water-soluble phenolic resin expanded approximately one half as much in both length and width as did untreated paper, and paper with 18 and 24% of resin expanded still less. Twenty-four per cent of resin appeared to be the approximate practical limit in regard to dimensional stability since higher resin contents, up to 33%, did not result in significant additional improvement. Increasing the water-soluble phenolic-resin content of the kraft paper decreased its rate of moisture adsorption and its equilibrium moisture content. Impregnation with an alcohol-soluble phenolic resin did not alter the actual equilibrium moisture content of the fiber substance.

THE NEED for papers with superior properties to meet the increased diversification of paper uses has stimulated the development of treated papers in which the inherent deficiencies are overcome or special requirements are met by the addition of chemicals or resins. Phenolic resins are among the most common materials selected to modify the properties of paper used for plastics or special products. Previous work on the impregnation of paper with phenolic resin has shown a considerable variation in the properties obtainable according to the type of resin and method of its addition. These effects are evident, particularly in such properties as equilibrium moisture content, dimensional stability, wet strength, and resistance to attack by fungi. In addition to the resin itself, among the most important factors in the impregnation of cellulose fibers is the type of solvent used as a carrier for the resin. For example, thorough penetration of the fiber wall with resin probably can be obtained only through the use of solvents that can swell cellulose. Complete penetration may be undesirable in many cases.

This report discusses briefly the effects of impregnation of kraft paper, primarily with water-soluble phenolic resin in various amounts up to about 35% resin. The papers were impregnated under conditions believed to give a good degree of resin penetration into both the fiber and the sheet structures. Some data are also reported on papers treated with alcohol-soluble phenolic resin under conditions believed to give good penetration of the sheet but poor penetration of the fiber. The resin in the impregnated papers was cured without pressure before evaluation. An analysis was made of specific effects observed, particularly on the effect of resin on the moisture sensitivity of the fiber and sheet. No attempt is made in this report to translate these effects in terms of possible uses to improve paper plastics, stabilize paper against dimensional change, or to suggest other applications.

PREPARATION OF TEST MATERIAL

In this report, the term "resin content" refers to the difference in weight of the untreated paper and the treated, cured papers, both dried at 105° C. It is expressed as a percentage of the weight of the latter. It was recognized that this is at variance with the way of expressing resin content usually used industrially. Various values for resin content can be obtained according to what value is used as the basis; for example, weight of the untreated paper, weight of the cured treated paper, or weight of the treated paper as it emerges from the impregnator drying tower.

The 9 and 14-mil kraft papers used in this study were made on the Forest Products Laboratory experimental paper machine from a commercial northern pine sulphate pulp. These papers were impregnated with a water-soluble phenolic resin to give resin contents of approximately 14, 18, 24, 27, and 33% for 9-mil paper and of 8, 12, 15, and 19% for 14-mil paper, based on the weight of treated paper after oven drying the cured sheets. Also, a commercially made 4.5-mil kraft paper was impregnated with approximately 18% each of water-soluble phenolic resin and alcohol-soluble phenolic resin. The resin in all impregnated papers was cured by heating in a hot press without pressure for 6 minutes at 325° F. Untreated 9 and 14-mil papers, for use as controls in moisture-adsorption and dimensional-stability tests, were given a similar heat treatment.

TESTING PROCEDURE

Air resistance (a measure of porosity), density, thickness, and stretch tests made on the paper conformed with the TAPPI Standard Methods of tests. Stretch

PARKER K. BAIRD, Chemist, ROBERT J. SEIDL, Chemical Engineer, and DONALD J. FAHEY, Technologist, Forest Products Laboratory, Maintained at Madison, Wis., in cooperation with the University of Wisconsin, Forest Service, U. S. Department of Agriculture.

values were obtained on specimens 1 inch wide. Stiffness values were obtained on the various resin-treated papers with the Askania stiffness tester.

The relative water-vapor-transmission rate was determined with a water-vapor-transmission cabinet. The exposure conditions were 100° F. and 92% relative humidity on the outside of a sealed dish containing calcium chloride.

The tensile strength of both treated and untreated paper was measured on a standard Schopper tensile-testing machine. The paper strips were 1 inch wide and 6 inches long. The initial distance between the jaws of the machine was 4 inches. The stressing jaw moved at the rate of 12 inches per minute. Specimens were tested with the machine direction of the sheet both parallel and perpendicular to the direction of the applied load. The tests were made on strips conditioned at 50% relative humidity and 75° F., and after soaking in water at 75° F.

For dimensional-stability and moisture-adsorption determinations, four specimens approximately $5^3/_4$ inches square were cut from the 9-mil treated papers. Specimens were also cut from the untreated 4.5-mil kraft paper and paper treated with water-soluble and with alcohol-soluble phenolic resins. Specimens were exposed at about 30% relative humidity for 2 weeks. Dimensional measurements in both the machine and cross-machine direction were made at this condition with a gage reading accurately to 0.001 inch. Weight measurements were also made at this condition with an analytical balance. Specimens were then exposed to each of the humidity conditions of about 50, 65, 80, and 90% for a period of 1 week. Measurements were made while the paper was at each of these conditions. The specimens were then oven dried for calculation of data.

To determine the effect of resin content on the rate of moisture absorption, three specimens approximately $5^3/_4$ inches square of each resin content of the 9-mil overlay paper were exposed to 33% relative humidity for more than 3 weeks. Weight determinations were made during this period. Specimens were then exposed to 90% relative humidity, and measurements were made every minute for the first 15 minutes of exposure and then at frequent intervals until weight equilibrium was obtained.

DISCUSSION OF RESULTS

A discussion of the relationships between resin content as previously defined and certain physical properties of the various papers follow. It is emphasized that the resin in all the treated papers was cured prior to testing.

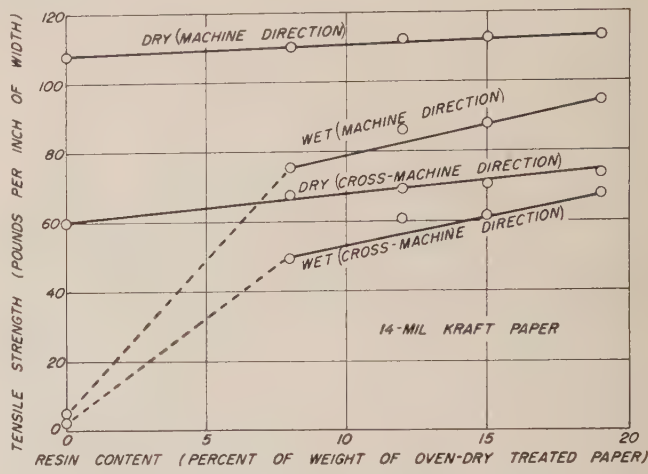


Fig. 1. Effect of resin content on dry and wet tensile strength

An increase in paper thickness was found to accompany an increase in resin content. This increase was at an approximately uniform rate within the range of resin contents studied. The nominal 9-mil paper when treated with 14% of water-soluble phenolic resin diluted with a 50–50 mixture of water and alcohol had a thickness of 10.4 mils after cure of the resin, or an increase in thickness of 17% based on the thickness of untreated paper. The corresponding increase in thickness for papers containing 18, 24, 27, and 33% resin was 24, 26, 31, and 37%, respectively.

The increase in thickness upon resin impregnation cannot be attributed to the resin alone. Soaking the 9-mil paper in water caused an increase in thickness of 10% based on an equilibrium condition with 50% relative humidity. Soaking the paper in a 50–50 mixture of water and alcohol increased the thickness 7% while soaking it in alcohol alone increased its thickness only 2.4%. Increase in thickness of un-

Table I. Physical Tests on Nominal 9 and 14-mil Kraft Papers Containing Various Amounts of Water-Soluble Phenolic Resin

Resin content, %	Basis (24 × 36—500), lb.	Thickness, mils	Density, g./cc.	Air-resistance (Gurley), sec. per 100	Tensile strength—Dry—Machine direction, lb./in. width	Tensile strength—Dry—Cross direction, lb./in. width	Tensile strength—Wet—Machine direction, lb./in. width	Tensile strength—Wet—Cross direction, lb./in. width	Stretch (Cross direction)—Dry, %	Stretch (Cross direction)—Wet, %	Stiffness (Askania)—Machine direction, points	Stiffness (Askania)—Cross direction, points
Nominal 9-mil paper												
0	97	8.9	0.60	79	73.6	40.4	3.3	2.7	6.0	...	30	18
14.1	115	10.4	0.61	54	77.2	46.7	62.6	42.4	2.9	5.9	42	25
18.1	119	11.0	0.60	50	77.4	53.8	69.9	46.5	2.5	5.1	45	27
24.4	126	11.2	0.62	50	78.5	59.6	73.8	50.1	2.1	3.8	55	29
27.2	130	11.6	0.62	63	80.5	61.2	75.8	52.5	1.9	3.1	53	30
33.0	143	12.2	0.65	50	83.8	61.8	82.8	55.4	1.5	2.3	55	31
Nominal 14-mil paper												
0	164	14.3	0.65	132	107.8	60.0	4.6	3.4	...	...	57	39
7.7	179	15.8	0.63	94	110.8	67.6	75.6	50.0	...	...	62	43
12.0	189	16.4	0.64	73	113.0	69.6	86.7	60.6	...	...	66	43
15.2	199	16.9	0.65	82	113.2	70.8	88.7	62.1	...	...	70	45
18.6	203	17.4	0.65	66	114.4	73.6	95.3	68.4	...	...	71	46

treated paper upon wetting and subsequent drying is probably caused by strain relaxation. In addition, the increase in thickness upon resin impregnation and drying is influenced by (1) deposition of resin in the fiber wall which maintains the fiber in a partially expanded condition, and (2) fiber dispersion caused by swelling forces or resin between fibers. Thus, the

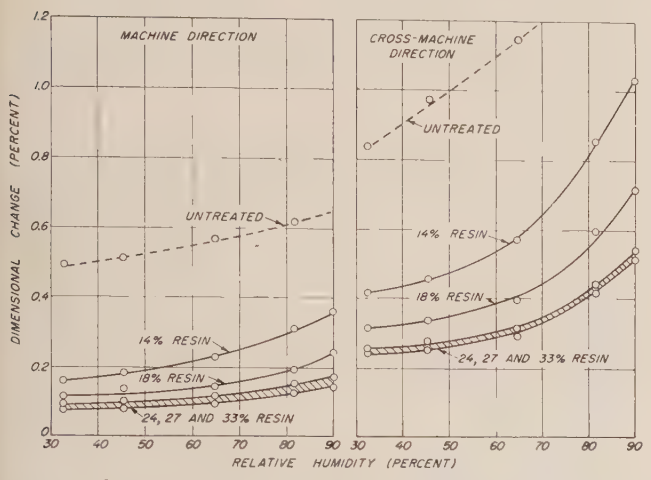


Fig. 2. Effect of resin content on the dimensional swelling of 9-mil kraft paper exposed to various relative humidities

change in thickness of the paper was dependent on the solvent used as the impregnating medium as well as on the amount of resin added.

The densities of the untreated 9 and 14-mil papers were 0.60 and 0.65 gram per cubic centimeter, respectively. The gain in weight of the paper due to resin impregnation was commensurate with increase in thickness, so that no significant change in density was obtained with increases in resin content.

Air resistance of paper as determined by the Gurley densometer is expressed in terms of the time in seconds required for 100 cc. of air to flow through a given area of paper. The reciprocal of this value is considered to be proportional to the porosity of the paper. The porosity is considered to be one measure of the structure of paper that influences resin absorption.

Air resistance values of 79 and 132 seconds per 100 cc. were obtained on the untreated 9 and 14-mil papers (Table I). An increase in resin content of 14-mil paper caused a decrease in this value indicating an increase in the porosity. The 14-mil papers containing 8, 12, or 19% of resin had values of 94, 83, and 66 seconds, respectively. The decrease in air resistance with increasing resin content of 9-mil paper, however, occurred only for the lowest resin content used, namely 14%. This increase in porosity may have been due to the resultant expanded thickness and increase in the pore fraction of the paper.

Although it was recognized that low-resin-content papers were not highly resistant to the passage of water vapor, it was thought such resistance would be of interest in measuring the effect of the impregnation and the subsequent swelling on the rate of water-vapor transmission through the sheet. The water-vapor transmission rate of the untreated 9-mil paper was over 200 grams per 100 square inches per 24 hours. Similar papers containing 14 to 33% resin had transmission rates of about 150 grams per 100 square inches per 24 hours and showed no significant differences within this range of resin contents.

It should be emphasized that the analysis of tensile strength was based on pounds per inch of width. It was recognized that strength analyses based on pounds per square inch would be considerably different. Tensile strength tests obtained on the various papers showed the effectiveness of resin impregnation in increasing the strength of the paper, especially that of specimens tested in the wet condition. Figure 1 and Table I show the effects of resin impregnation on the tensile strengths of 14-mil paper in both the machine and cross-machine directions. A greater proportional increase in dry strength was obtained in the cross-machine direction than in the machine direction by the addition of resin. For example, the 14-mil paper treated with 15% of resin had a dry strength in the cross-machine direction of about 18% more than the untreated paper, while the corresponding increase in the machine direction was only 5%.

The disproportionate increase in cross-machine dry tensile strength may be partially attributable to an improved bonding or to the greater number of contact points caused by the presence of resin between parallel fibers perpendicular to the cross-machine direction. Contact may have been further enhanced by the greater swelling in diameter of fibers that occurred upon resin impregnation. Furthermore, it appeared that resin impregnation was more effective in increasing the dry tensile strength in both directions of 9-mil than of 14-mil paper. The dry strength of both untreated papers in the machine direction was 1.8 times as great as that in the cross-machine direction. This ratio was reduced slightly in the treated papers.

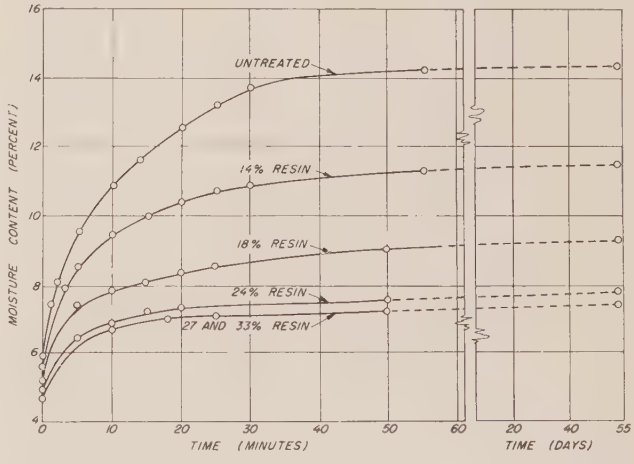


Fig. 3. Rate of adsorption of moisture by 9-mil kraft paper, containing various amounts of water-soluble phenolic resin, upon exposure to a relative humidity of 90%

Moisture content at zero time is the equilibrium content at 30% relative humidity. Calculations based on weight of sample at 30% relative humidity.

The untreated 9 and 14-mil papers lost approximately 95% of their strength after soaking 48 hours in water. These papers, when impregnated with about 15% of resin, lost only about 20% of their tensile strength in the machine direction after soaking. The corresponding loss in the cross-machine direction was only about 10%. The papers containing higher resin contents

Table II. Dimensional Changes in 9-mil Kraft Paper Containing Various Amounts of Water-Soluble Phenolic Resin under Various Moisture Conditions

Resin content, %	Percentage of dimensional change[a]									
	Machine direction at relative humidity (per cent) of:					Cross-machine direction at relative humidity (per cent) of:				
	33	46	65	82	90	33	46	65	82	90
0	0.48	0.51	0.56	0.61	0.64	0.84	0.96	1.14	1.53	1.81
0[b]	0.45	0.48	0.52	0.55	0.57	0.83	0.93	1.08	1.42	1.72
14	0.17	0.18	0.22	0.30	0.35	0.41	0.45	0.56	0.85	1.02
18	0.11	0.13	0.14	0.19	0.23	0.31	0.33	0.39	0.59	0.71
24	0.09	0.11	0.13	0.15	0.16	0.24	0.27	0.31	0.47	0.54
27	0.07	0.07	0.08	0.07	0.12	0.23	0.25	0.28	0.41	0.53
33	0.09	0.10	0.14	0.13	0.18	0.22	0.26	0.30	0.41	0.58

[a] Change in dimensions caused by subjecting material to the indicated relative humidity and then oven drying. Percentage of change based on oven-dry dimensions.
[b] Paper given the same heat treatment as the treated papers.

retained even a higher proportion of their original strength.

Tensile strengths of both the treated and untreated papers were tested by an engineering method in addition to the method previously described. This engineering method involved a slower rate of loading than the TAPPI method. Results of tests showed higher ultimate tensile strength for the treated papers loaded at the slower rate, but there was no significant difference for the untreated papers. Also, increases in resin content had a greater effect on the tensile strength of the paper, especially when tested dry by the engineering method.

Stretch (the elongation at failure in tension) determined on the untreated and treated 9-mil paper in the cross-machine direction for both the dry and the wet condition is shown in Table I. The paper treated with 14% of water-soluble phenolic resin stretched in the dry condition about 50% as much as the untreated paper. Paper treated with 18 and 33% resin-yielded stretch values of 40 and 25% of that of the untreated paper. The stretch of the paper in the wet condition was approximately twice as much as in the dry condition for resin contents up to about 24%. The reduction in stretch incident to resin impregnation may be an indication of the embrittlement characteristic of papers impregnated with water-soluble phenolic resins.

The stiffness (Table I) of the paper in both the machine and the cross-machine direction as determined by the Askania stiffness tester increased with increasing resin content. The stiffness in the machine direction was approximately $1^1/_2$ times that in the cross-machine direction. The 14-mil paper also had a stiffness at least $1^1/_2$ times as great as that of the 9-mil paper. The data on stiffness are useful for comparative purposes only, since the results are not expressed in the engineering units usually employed. The increase in stiffness is no doubt due to the swelling effect of the solution which caused an increase in thickness of the paper as well as a stiffening of the fibers themselves.

Paper, like wood, expands with increase in moisture content more in the cross-grain direction than in the grain direction. The expansion of the untreated and treated paper as shown in Table II was between two and three times greater in the cross-machine than in the machine direction. Resin impregnation was effective in reducing the swelling in both the machine and cross-machine directions of the paper.

The effect of resin content on the dimensional swelling in the cross-machine direction of the 9-mil paper is shown in Fig. 2. Paper treated with 14% of resin had a dimensional swelling about one half as much as untreated paper (not heat treated) after exposure to various relative humidities. Under the same conditions a paper containing 18% of resin swelled only about 40% as much as untreated paper. A further reduction in dimensional growth was obtained with the use of 24% of resin, but 27 and 33% of resin caused only a slight additional reduction. Increases in resin content reduced the dimensional swelling in the machine direction in approximately the same proportion as obtained in the cross-machine direction (Fig. 2).

Samples of untreated paper were exposed to the same heat treatment that was used for curing the resin in the treated papers. This treatment reduced the swelling of the paper slightly. As an example, the paper subjected to the heat had a dimensional change in the cross-machine direction of 1.4% for a change in exposure from 82% relative humidity to an oven-dry condition, as compared to 1.5% for paper not subjected to the heat.

To determine the rate of moisture adsorption and the effect of water-soluble-resin content on the rate of adsorption for a humidity change of from 33 to 90% relative humidity, samples of untreated and treated papers were conditioned to equilibrium in 33% relative humidity and were then exposed to 90% relative humidity. Weight measurements were made every minute for the first 15 minutes after exposure and at frequent intervals thereafter. The greatest change in

Table III. Equilibrium Moisture Content of 9-mil Kraft Paper Containing Various Amounts of Water-Soluble Phenolic Resin at Various Relative Humidities

Resin content, %	Percentage of moisture based on oven-dry weight of fiber at relative humidity (per cent) of:					Percentage of moisture based on oven-dry weight of fiber plus resin at relative humidity (per cent) of:				
	33	46	54	82	90	33	46	65	82	90
0	6.0	7.3	8.7	14.4	18.4	...	...	...	...	...
0[a]	6.1	7.4	8.6	13.9	18.3	...	...	...	...	...
14	5.5	6.2	7.0	11.7	14.0	4.6	5.2	6.0	9.9	11.8
18	5.4	6.1	6.6	10.6	11.7	4.1	4.7	5.1	8.4	9.8
24	5.2	5.7	6.3	9.5	11.2	3.8	4.2	4.6	7.1	8.4
27	5.0	5.5	6.1	9.0	11.3	3.6	3.9	4.3	6.5	8.1
33	5.6	6.2	6.8	9.3	12.0	3.7	4.0	4.4	6.1	8.0

[a] Specimens given the same heat treatment as the treated papers.

Table IV. Effect of Alcohol-Soluble and Water-Soluble Phenolic Resins on Properties of 4.5-mil Kraft Paper

Resin used	Basis weight (25 × 36—500), lb.	Thickness, mils	Density g./cc.	Tensile strength — Dry — Machine direction, lb./in. width	Tensile strength — Dry — Cross direction, lb./in. width	Tensile strength — Wet — Machine direction, lb./in. width	Tensile strength — Wet — Cross direction lb./in. width	Dimensional change[a] Machine direction, %	Dimensional change[a] Cross direction, %
None	51.2	4.3	0.68	35	27	3	2	0.61	1.22
Alcohol-soluble type[b]	62.5	4.7	0.75	51	40	39	22	0.41	1.08
Water-soluble type[b]	63.5	6.0	0.60	50	30	40	28	0.21	0.53

[a] Change in dimensions caused by oven-drying material containing moisture at equilibrium with 90% relative humidity. Percentage of change based on oven-dry dimensions.
[b] Resin content 18%, based on weight of treated paper after oven drying

moisture content occurred in the first few minutes, as shown in Fig. 3. The rate of change was greater for the untreated paper than for the treated paper, and increasing resin content decreased the rate of adsorption. It appeared from these tests that the equilibrium moisture content was substantially obtained in the first hour of exposure. Weight measurements made at weekly intervals up to 55 days showed no significant changes.

The addition of a water-soluble phenolic resin resulted in a decrease in the equilibrium moisture content of the kraft paper. This fact is clearly evident when changes are calculated on the basis of dry fiber instead of on the basis of fiber plus resin as shown in Table III. If the resin had no effect on the sensitivity of the fiber for moisture, the equilibrium moisture content of the fiber substance would be unchanged by the addition of the relatively nonhygroscopic resin, but its addition could reduce the apparent equilibrium moisture content of the mixture. That the resin did affect the hygroscopicity of the fiber substance is shown in Figs. 3–5.

The equilibrium moisture content, which affects the dimensional stability of impregnated papers, may be influenced by the deposition of resin in the fiber cell wall, mechanical restraint of fiber and sheet dimensions, and chemical action between resin and fiber. If the quantity of resin deposited in the fiber cell wall were known, it would then be theoretically possible to calculate its effect upon the equilibrium moisture content by using the volume of resin deposited and the equivalent volume of water displaced.

Figure 6 shows the relationships between dimensional change of the sheet and equilibrium moisture content based on the fiber alone in the humidity range from 33 to 90%. If dimensional stability were dependent only upon equilibrium moisture content, all points on the figure would be expected to be along a single line; but the fact that a family of curves resulted from these data is evidence that the resin has a contributory effect on stability beyond that due to equilibrium moisture content. For example, paper containing 14% resin having an equilibrium moisture content of 11.7 (82% relative humidity) based on oven-dry fiber had a dimensional growth of 0.85% in the cross-machine direction as compared to 0.71% obtained from a sheet having the same equilibrium moisture content (90% relative humidity) but containing 18% resin.

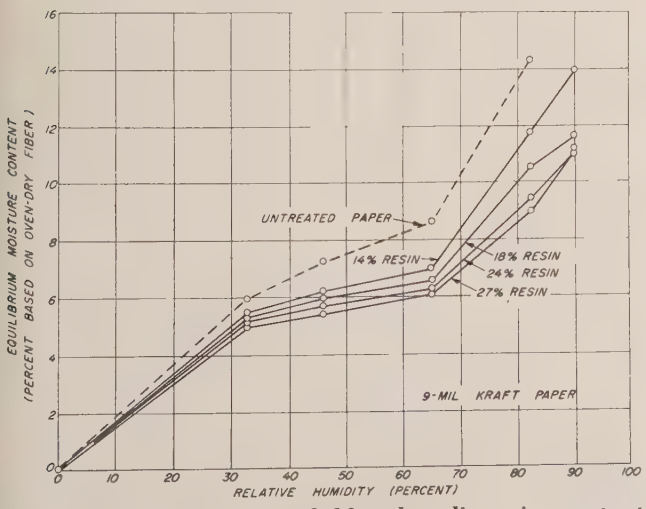


Fig. 4. Effect of water-soluble phenolic-resin content on the equilibrium moisture content

Water-soluble and Alcohol-soluble Resins

The characteristics imparted to cellulose fiber sheets by water-soluble and alcohol-soluble phenolic resins were known to be greatly different. To determine the extent of the differences 4.5-mil kraft paper was impregnated with each of the two types to a resin content of 18% based on the oven-dry weight of the treated paper after cure of the resin. The differences between the two papers are shown in Tables IV and V.

A comparison of the use of water-soluble-resin and alcohol-soluble-resin saturants indicated that the tensile strength in the wet condition of the paper impregnated with a water-soluble resin was greater than that obtained from a paper containing an equal amount of alcohol-soluble resin, especially in the cross-machine direction. The tensile properties of these papers when dry indicated the opposite to be true. The type of tension failure for wet specimens representing each resin is shown in Fig. 7. The fibrous nature of the paper

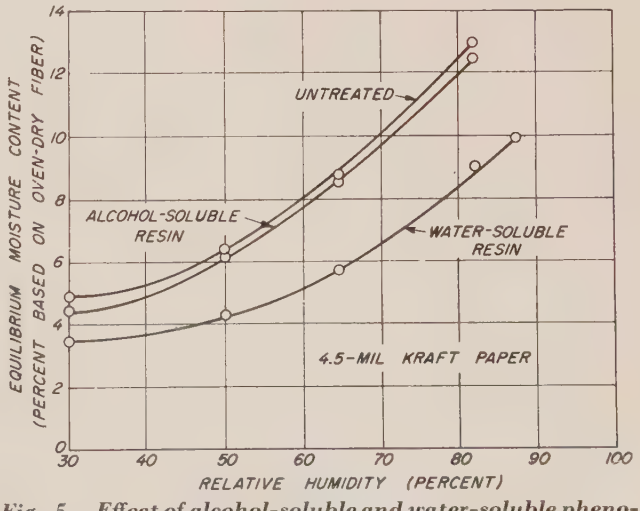


Fig. 5. Effect of alcohol-soluble and water-soluble phenolic resins on the equilibrium moisture content

Resin content about 18% based on oven-dry weight of treated paper after cure of the resin.

Table V. Effect of Alcohol-Soluble and Water-Soluble Phenolic Resins on the Equilibrium Moisture Content of 4.5-mil Kraft Paper

Relative humidity, %	*Percentage of equilibrium moisture content[a] — Of paper treated with: Of untreated paper*	*Alcohol-soluble resin[a]*	*Water-soluble resin[b]*
30	4.73	4.48	3.29
50	6.29	6.25	4.19
65	8.66	8.64	5.77
82	13.25	12.76	8.97
88.5	16.36	15.00	9.78

[a] Based on oven-dry weight of fiber.
[b] Resin content of paper was 18% of weight of oven-dry treated paper.

break in the case of the alcohol-soluble resin is no doubt due in part to the less thorough impregnation of the fibers because of the larger molecular size of the resin, and to its nonaqueous diluent. There was no obvious difference, however, between the two resins in the type of tension failure for the dry specimens. It is interesting to note the relative swelling in thickness due to impregnation For instance, passing the paper through a water-soluble resin increased the thickness from 4.3 to 6.0 mils, while the use of alcohol-soluble resin yielded a thickness value of 4.7 mils.

The equilibrium moisture content of paper containing the water-soluble resin was appreciably lower at all humidities than that of paper containing an equal amount of alcohol soluble resin (Table V and Fig. 5). The dimensional stability of the paper treated with water-soluble resin was much greater. The equilibrium moisture content of the paper treated with alcohol-soluble resin, when based on the oven-dry weight of the fiber alone, was nearly as high as that obtained from untreated paper, and the dimensional swelling in the cross-machine direction was nearly as great as that of untreated paper. When water-soluble resin was used, the dimensional swelling in the cross-machine direction was reduced to less than one-half that of either untreated paper or paper with alcohol-soluble resin. A probable explanation is that the penetration of the fiber cell wall with the alcohol-soluble resin is not so great as that of the water-soluble resin. The

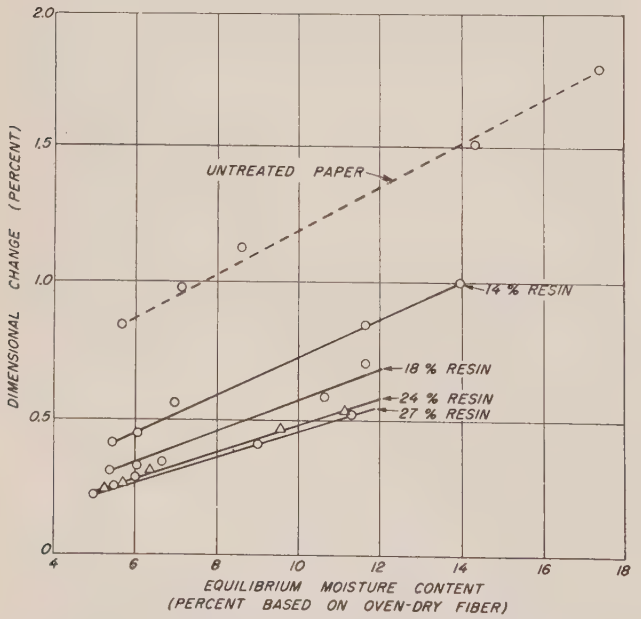


Fig. 6. Relation of the equilibrium moisture content of water-soluble phenolic-resin impregnated 9-ml kraft paper to cross-machine dimensional change

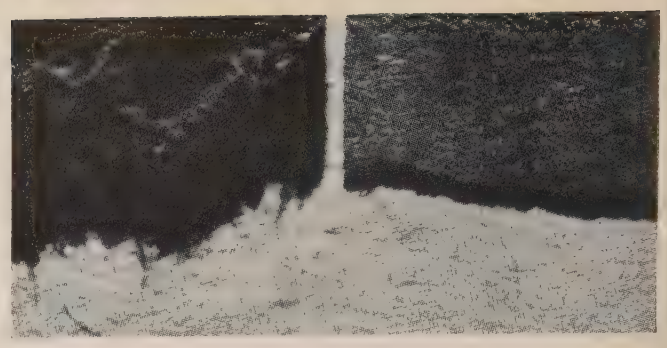


Fig. 7. Type of tension failure for samples of resin-treated paper tested when wet after soaking 48 hours in water

Left, alcohol-soluble phenolic-resin paper; *right*, water-soluble-phenolic-resin paper.

latter tends to maintain the fiber in a swollen condition. Additional evidence that the penetration of the fiber itself with water-soluble resin is greater and that the equilibrium moisture content of the fiber itself is lower than that obtained with alcohol-soluble resin, is further indicated by results of tests made on these papers that showed the paper treated with water-soluble resin to be much more decay resistant. Higher moisture contents encourage the growth of fungi, while resins themselves are not especially inhibitive.

The relationships between dimensional stability and equilibrium moisture content have been emphasized because they are believed to be basic in the field of dimensional stability of paper and fiber products.

CONCLUSIONS

The following conclusions are drawn from the data obtained under the conditions described:

1. The thickness of kraft paper increased at an approximately uniform rate for a range of resin contents between 8 and 33%. Resultant density of the paper was not greatly affected by treatment with water-soluble phenolic resin inasmuch as the swelling was compensated by the addition of resin.

2. Impregnation with phenolic resin resulted in an increase in tensile strength in pounds per inch of width in both the dry and the wet condition, particularly the latter. The resin caused a greater increase in cross-machine than in machine-direction tensile strength. The greatest proportional increase in wet strength was obtained with the first amount of resin.

3. Impregnation with a water-soluble phenolic resin reduced the swelling of the paper in all dimensions upon exposure to various humidity conditions. About 24% resin content appeared to have about the maximum restraining effect on swelling in proportion to resin content. The dimensional change in the cross-machine direction was more than twice that in the machine direction for the treated and untreated paper under various humidity conditions.

4. Increase in water-soluble resin content of kraft paper decreased the equilibrium moisture content at all humidities, as well as the rate of adsorption of moisture at 90% from conditions at 30% relative humidity. Impregnating the paper with alcohol-soluble resin did not alter the equilibrium moisture content of the fiber substance.

Received Nov. 7, 1949. Presented at the Fall Meeting of the Technical Association of the Pulp & Paper Industry, Portland, Ore., Sept. 11–15, 1949.

Penetration of Neutral Sulphite Cooking Liquors into Yellow Birch Wood

VICTOR J. WIRPSA and C. E. LIBBY

The degree of penetration of liquor into 2-foot yellow birch logs when cooked with neutral sulphite liquor was determined and the influence on penetration of the following variables was investigated: (1) pre-evacuation of air from digester, (2) use of hydrostatic pressure, (3) combination of pre-evacuation and hydrostatic pressure, (4) chemical concentration of liquor, (5) use of wetting agents, (6) storage of logs after cooking, and (7) moisture content of logs before cooking. Tables of data and graphs showing the relative effect of these several variables are presented. In connection with this investigation a method for the qualitative estimation of the extent of penetration of sodium into wood was developed. Using standard quantitative methods of analysis a determination was made of the distribution of chemicals throughout the penetrated zone of seasoned yellow birch sapwood and heartwood. The results of these researches have been confirmed by pilot-plant scale tests conducted in the laboratories of the New York State College of Forestry.

THE investigation described in this paper was undertaken to develop original data concerning the penetration of salt-bearing liquors into birch hardwood blocks. The research was carried on simultaneously with a semicommercial project which had as its principal objective the manufacture of satisfactory mechanical pulps from the dense hardwoods. In the semicommercial project 2-foot and 4-foot blocks of hardwood were treated in a closed digester with chemical liquors of varying composition and the blocks then ground on a conventional wood pulp grinder. The pulp manufactured by this process was far superior in strength properties to commercial spruce groundwood pulps, and it was felt that this result must be due to penetration of the liquors into the blocks followed by some interaction of their chemical constituents with the noncellulosic components of the wood that bound the fibers together. Search of the literature revealed that several investigators had treated wood in a similar manner but there was no evidence to indicate that any attempt had ever been made to make a precise determination of the extent of this penetration. Development of a procedure for securing these data when neutral sulphite liquors were employed, together with an exploration of the several factors influencing penetration, were therefore established as the prime objectives of this project.

TESTING METHODS

In connection with this research project a unique method was developed for indicating qualitatively the extent of sodium-bearing liquor penetration into the wood blocks. This procedure was an adaptation of the quantitative method for the determination of sodium described by TAPPI official standard T-623 m-44. The reagent employed in this test was prepared by dissolving 77 grams of C.P. uranyl acetate in 800 ml. distilled water and 14 ml. of glacial acetic acid in a liter volumetric flask. The solution was warmed and stirred to complete solution of the uranyl acetate. Zinc acetate to the extent of 231 grams was then added in small quantities until dissolved. This was followed by 7 ml. of glacial acetic acid and the solution made up nearly to volume. After cooling to 20°C. the volume was brought to exactly 1000 ml. with distilled water and then filtered. If on standing no further precipitation took place, a few milligrams of sodium chloride were added to insure that the reagent was saturated with the triple salt of sodium-uranyl-zinc acetate. The solution was always freshly filtered before use.

In applying this reagent to treated wood blocks, the block was cut along the direction of liquor penetration. The cut surface was then sandpapered to a smooth plane with a fine clean piece of sandpaper. Freshly filtered uranyl-zinc-acetate reagent was then poured onto the sandpapered surface and allowed to stand for about 30 minutes and the excess then drained off by tipping the block. The block was then allowed to dry and if sodium salts from the treating liquor were present in the wood, they would react with the reagent to form a bright lemon-yellow precipitate. The amount of salt precipitated was proportional to the amount of sodium in the wood.

It should be mentioned that an attempt was made to develop a quantitative method for estimating the amount of sodium in wood utilizing the color reaction of the uranyl-zinc-acetate reagent. The procedure employed was a modification of that developed by Bradbury* for measuring the concentration of sodium salts in blood. Thin disks of treated wood were cut out of the block with a band saw, extracted with distilled water until the sodium salts had all been leached out, and an aliquot portion mixed with a measured quantity of the reagent. The resulting yellow coloration of the solution varied in depth with the quantity of salt extracted and was measurable with a Klett-Summerson Photoelectric Colorimeter. However, it was found that a slight error was introduced because of the extraction of small quantities of coloring matter in the wood and the method was finally abandoned in favor of the more tedious gravimetric determination of sodium made in accordance with the standard analytical method of TAPPI, T-623 m-44. The salt-bearing

VICTOR J. WIRPSA, New Product Development and Sales, the St. Regis Sales Corp., Kalamazoo, Mich. Formerly graduate student, Department of Pulp and Paper Manufacture, New York State College of Forestry, Syracuse, N. Y.
C. E. LIBBY, Professor of Pulp and Paper Manufacture, New York State College of Forestry, Syracuse, N. Y.

* Bradbury, James T., *J. Lab. Clin. Med.* 31, No. 11: 1257–1261 (Nov., 1946).

extract was prepared by cutting disks 3/4 of an inch thick from both ends of the log at 3, 6, and 9 inches distance from the ends. The sapwood and heartwood portions of each disk were separated, cut into convenient pieces with a band saw, and placed in individual tared leaching bottles. The weight of the bottle and wet wood was obtained, then the bottles and contents placed in a drying oven maintained at 105°C. for at least 24 hours. After obtaining the oven-dry weight, 250 ml. of distilled water were added to each bottle containing the sapwood, and 25.0 ml. to each bottle containing the heartwood, and the wood sections leached for 72 hours. After the leaching period, a portion of the leach water was centrifuged to remove any suspended fibers or sawdust and 2 ml. of the clear liquid analyzed gravimetrically for sodium content as described. The sodium content was then calculated as milligrams of sodium per gram of oven-dry wood for each heartwood and sapwood section. Average results from both ends of the logs at the various distances were then computed. The amount of chemical in the treating liquor, sodium sulphite and sodium bicarbonate, (Na_2SO_3 + $NaHCO_3$) which had penetrated into the log was assumed to be proportional to the sodium content of the log; hence, the sodium content was assumed to give a measure of the degree of penetration.

Table I. Treating Conditions and Their Influence on the Penetration of Neutral Sulphite Liquors into Birch Logs

			Cooking conditions (all cooks at 140°C. for 6 hr.)				*Amount of sodium in milligrams Na per gram O.D. wood*			
							At 3, 6, and 9 inches from end of 24-in. log (average of both ends)		*Average between 3 and 9 inches*	
Cook No.	*Moisture content of logs, %*	*Type of cook*	*Liquor concentration mg./ml. sodium*	*Pre-evacuation*	*Pressure, p.s.i.*	*Distance from end of log, in.*	*Sapwood*	*Heartwood*	*Sapwood*	*Heartwood*
1	68.3	Plain	49.1	None	43	3	8.81	2.81	7.03	1.57
						6	6.50	1.12		
						9	5.78	0.77		
2	70.4	Plain	50.3	None	43	3	8.36	2.32	6.79	1.39
						6	6.45	1.03		
						9	5.56	0.83		
3	62.1	Pre-evacuation	50.7	23.5 in. 45 min.	43	3	10.21	5.03	7.40	2.72
						6	6.30	2.11		
						9	5.70	1.02		
4	68.0	Pre-evacuation	49.5	23.5 in. 45 min.	43	3	11.50	4.21	7.62	2.37
						6	6.08	2.22		
						9	5.27	0.69		
5	61.7	Hydrostatic	50.0	None	200–225	3	14.20	7.49	10.44	4.60
						6	8.80	3.43		
						9	8.32	2.88		
6	61.5	Pre-evacuation plus hydrostatic pressure	50.4	23.5 in. 45 min.	200–225	3	15.09	8.63	12.51	5.76
						6	11.15	4.78		
						9	11.30	3.88		
7	68.3	Plain, high liquor concentration	76.1	None	43	3	15.25	3.25	10.72	1.78
						6	8.88	1.60		
						9	8.02	0.48		
8	65.4	Plain, low liquor concentration	24.8	None	43	3	4.72	0.71	3.27	0.29
						6	2.95	0.15		
						9	2.15	0.00		
9A	67.8	Pre-evacuation and hydrostatic pressure wetting agent, immediate analysis [redacted]	51.0	23.5 in. 45 min.	200–225	1.5	27.25	21.09		
						3	19.21	15.15	14.28	8.67
						6	12.87	6.77		
						9	10.75	4.08		
9B	67.3	Pre-evacuation and hydrostatic pressure wetting agent, storage for 96 hours [redacted]	51.0	23.5 in. 45 min.	200–225	1.5	26.77	20.77		
						3	17.69	13.50	14.61	9.06
						6	13.43	8.05		
						9	12.70	5.62		
10A	81.3	Plain, high moisture content	49.6	None	43	1.5	11.15	4.02		
						3	6.45	1.11	3.96	0.47
						6	3.33	0.30		
						9	2.10	0.00		
10B	58.7	Plain, low moisture content	49.6	None	43	1.5	21.54	7.82		
						3	13.00	4.00	8.36	2.02
						6	7.21	1.55		
						9	4.88	0.52		

EXPERIMENTAL COOKING PROCEDURES

Equipment

The wood blocks were cooked in a horizontal type rotary digester having a capacity of 5 cubic feet. When loaded with one log approximately 8 inches in diameter and 2 feet in length about 35 gallons of liquor were required to fill the digester; with two logs 28 gallons of liquor were required. The digester was equipped with a vacuum pump which could be used to exhaust the air to a vacuum of 23 inches of mercury, and a pressure pump capable of producing hydraulic pressures of 225 p.s.i. for the duration of the cook. Heat was applied directly to the under side of the digester by means of gas burners and temperature of the liquor was recorded on a Taylor recording thermometer from a thermocouple inserted to a depth of about 1 foot into the digester head.

Treating Variables

It was desired to investigate the influence of such factors as pre-evacuation, hydrostatic pressure, and the use of wetting agents on liquor penetration into the

hardwood blocks. Accordingly a series of cooks on yellow birch were scheduled to be run under the following conditions:

1. Application of 23 inches of vacuum.
2. Introduction of cooking liquor under vacuum.
3. Raising of temperature by direct heating to 140°C. in about 45 minutes and maintaining this temperature by manual control to +3°C.
4. Application of hydrostatic pressure up to 225 p.s.i. total pressure (steam ± hydrostatic) for the duration of the cook without dilution of the liquor.
5. Quick removal of the treated log after the cook for immediate determination of the degree of penetration.

Wood Preparation

A number of debarked, slightly seasoned yellow birch logs were cut into approximately 2-foot lengths and stored over water in a large covered metal drum. The logs, free of any checks, were placed in the drum to prevent any further drying out and to allow the moisture to become more uniformly distributed within each log. A minimum period of 2 months was allowed for storage.

It was desirable to utilize logs of similar moisture contents and only those logs with calculated moisture contents between 60 and 70% were chosen for the cooks, except cooks 10A and 10B (one cook, two logs) where logs of a higher and lower moisture content were desired. It was necessary to use wood of relatively high moisture content in order to insure using wood as free of checks as possible.

Since any direct method for determination of moisture content would necessitate cutting up or complete drying out of the logs, an indirect method was employed. The volume of each log was calculated from its dimensions and at least four measurements of each diameter and four measurements of length were taken to obtain the dimensions. Assuming a density of 0.55 gram of oven-dry wood per cubic centimeter of wet volume (34.32 pounds per cubic foot), the apparent oven-dry weight of the log was calculated from its volume. Knowing the wet weight of the log, the apparent amount of moisture was readily obtained and the apparent moisture content calculated. All moisture contents reported in this paper are based on the oven-dry weight of the wood.

Liquor Preparation

In all cases, with the exception of cooks 7 and 8, a liquor was employed having a concentration approximately equivalent to 1 pound of chemicals per gallon of liquor, calculated as sodium carbonate (Na_2CO_3). The ratio of the components of the cooking liquor was 6 parts of sodium sulphite (Na_2SO_3) to 1 part of sodium bicarbonate ($NAHCO_3$). Actually, since the degree of penetration was to be measured by the amount of leachable sodium present in the cooked log, the liquor in all cases, except cooks 7 and 8, was so adjusted as to contain 50 mg. of sodium per ml. plus or minus 1 mg. In cooks 7 and 8, where the liquor concentration factor was investigated, liquors were used having a concentration of 75 and 25 mg. sodium per ml., respectively. In all cooks, the digester was filled to the same level with treating liquor.

Cooking Conditions

All cooks were carried out for 6 hours at 140°C., which included a 45-minute period for reaching temperature. After 6 hours of cooking, the pressure was relieved, liquor drained, and the log removed for sectioning and analysis.

In the cooks where pre-evacuation was employed, a vacuum equivalent to 23.5 inches of mercury was applied for 45 minutes before introduction of the cooking liquor into the digester which was still under vacuum. By means of direct heat and by use of a removable insulating shield placed over the digester, it was possible to reach 140°C. in about 45 minutes.

In the cooks where hydrostatic pressure was employed a steam-operated pump with a capacity of 200 to 225 p.s.i. was connected to the digester. The hydrostatic pressure was maintained by continually pumping cooking liquor into the digester to replace any loss due to slight leakage. The hydrostatic pressure was applied as soon as the temperature reached 140°C. and maintained for the remainder of the cook.

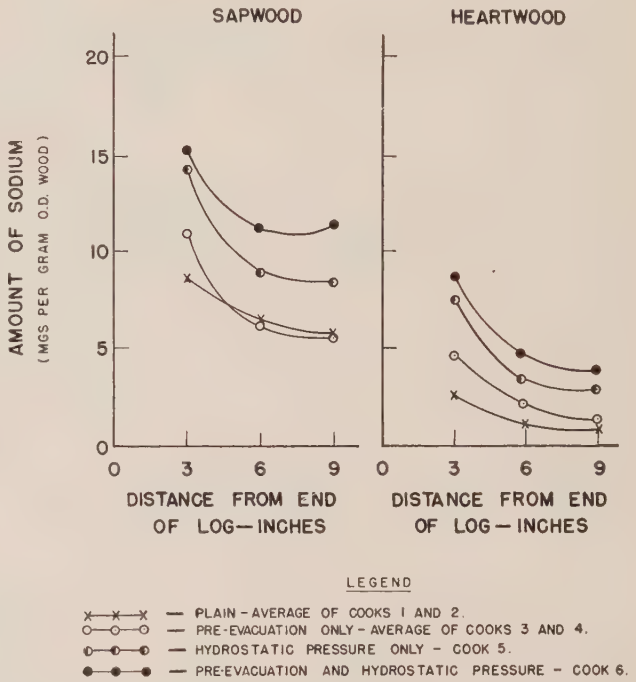


Fig. 1. Effect of pre-evacuation and hydrostatic pressure on penetration

Measuring Degree of Penetration

The cooked log, immediately upon removal from the digester, was superficially washed with water to remove excess liquor. Disks about 1/4 inch thick were cut from both ends of the log at 3, 6, and 9 inches distance from the ends. In cooks 9 and 10 additional disks at 1.5 inches from the ends were also obtained. The sapwood and heartwood portions of each disk were separated, cut into convenient pieces with a band saw, and placed in individual tared leaching bottles. The weight of bottle and wet wood was obtained, then the bottles and contents placed for at least 24 hours in a drying oven operated at 105°C. After obtaining the oven-dry weight, 250 ml. of distilled water (leach) was introduced into each bottle containing sapwood, and

25 ml. into each bottle containing heartwood. These amounts of leach water were sufficient to completely cover the wood after sinkage.

A "leach-rate" experiment, conducted on sections from the first cook, disclosed that 24 hours was sufficient to complete the extraction of the sodium salt. As an added precaution, and for the sake of convenience, a minimum of 64 and a maximum of 72 hours was allowed for the leaching of the sodium constituent.

After the leaching-out period, a portion of the leach water was centrifuged to remove any suspended fibers or sawdust, and 2 ml. of the clear liquid analyzed for sodium content by the gravimetric method described under the standard method of TAPPI, T-623 m-44. The sodium content was then calculated as milligrams of sodium per gram of oven-dry wood for each heartwood and sapwood section. Average results from both ends of the logs at the various distances were computed. The quantity of cooking liquor chemicals penetrated into the log was assumed to be proportional to the sodium content of the log; hence the sodium content was assumed to give a measure of the degree of penetration.

DISCUSSION OF EXPERIMENTAL RESULTS

A summary of the results of all cooks made during this investigation is given in Table I, which also contains a description of the conditions under which each cook was carried out and the moisture content of the logs before cooking.

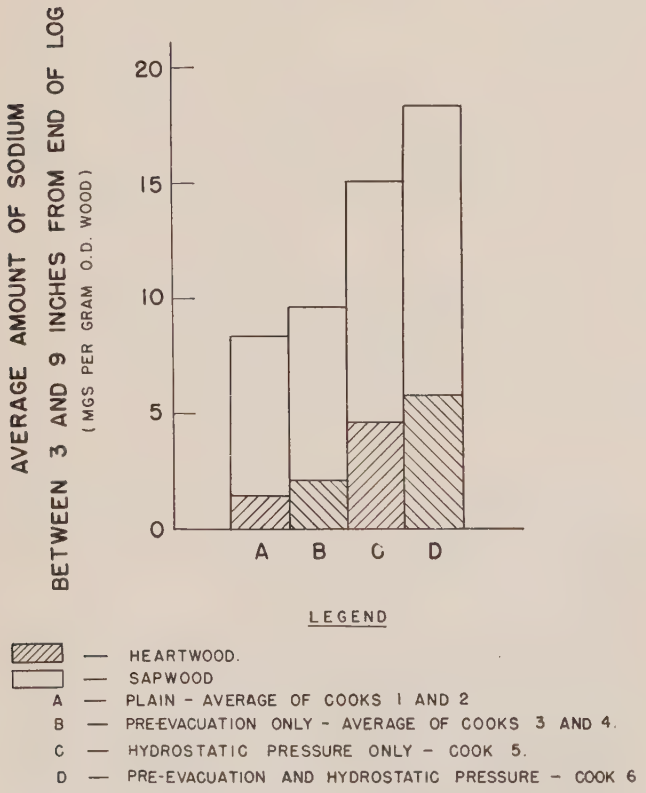


Fig. 2. Effect of pre-evacuation and hydrostatic pressure on penetration

The results recorded in Table I are graphically represented in Figs. 1 through 9. It was considered best to differentiate between the data for sapwood and heartwood when constructing the graphs because of the dissimilarity of the two in respect to ease of penetration.

Effect of Pre-evacuation and Hydrostatic Pressure

Cooks 1 through 6 constitute a series in which the influence of pre-evacuation and application of artificial pressure on the penetration of the cooking liquors into the logs was investigated. The first two cooks were standard cooks in that neither pre-evacuation nor hydrostatic pressure was employed. Cooks 3 and 4 were duplicate cooks using pre-evacuation only. Cook 5 was carried out under the same conditions as cooks 1 and 2 except that a total pressure of 200 to 225 p.s.i. was used. In cook 6 both pre-evacuation and hydrostatic pressure were used (see Table I for details of conditions).

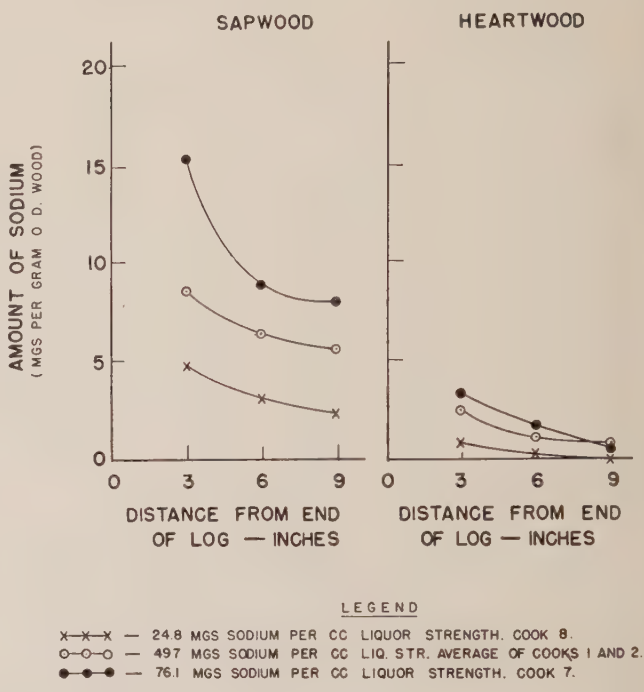


Fig. 3. Effect of liquor concentration on penetration

The comparison of results is shown graphically in Figs. 1 and 2. Four curves represent the results of six cooks because average values of cooks 1 and 2 and cooks 3 and 4 were used.

Figure 1 shows that use of pre-evacuation (23.5 inches vacuum for 45 minutes) seems to have but a slight effect on penetration into the sapwood but a decided effect in increasing the penetration into the heartwood. The increase seems greater up to 3 inches from the end of the log than beyond this distance.

A definite and appreciable increase in penetration throughout the whole log is effected by using a total pressure (steam + hydrostatic) of 200 to 225 p.s.i. as is evidenced from the results of cook 5. An inspection of Fig. 2 indicates that use of hydrostatic pressure almost doubled the sodium content of the plain cook in respect to both heartwood and sapwood.

The use of both pre-evacuation and artificial pressure appears to result in an increase in penetration greater

that the cumulative increases caused by pre-evacuation and hydrostatic pressure when used separately. This observation seems to be particularly true of penetration into the sapwood, although penetration into heartwood is similarly affected but to a lesser extent.

Effect of Liquor Concentration

Figures 2 and 3 show the effect of varying the concentration of chemicals in the cooking liquor on the degree of penetration. The graphs make a comparison

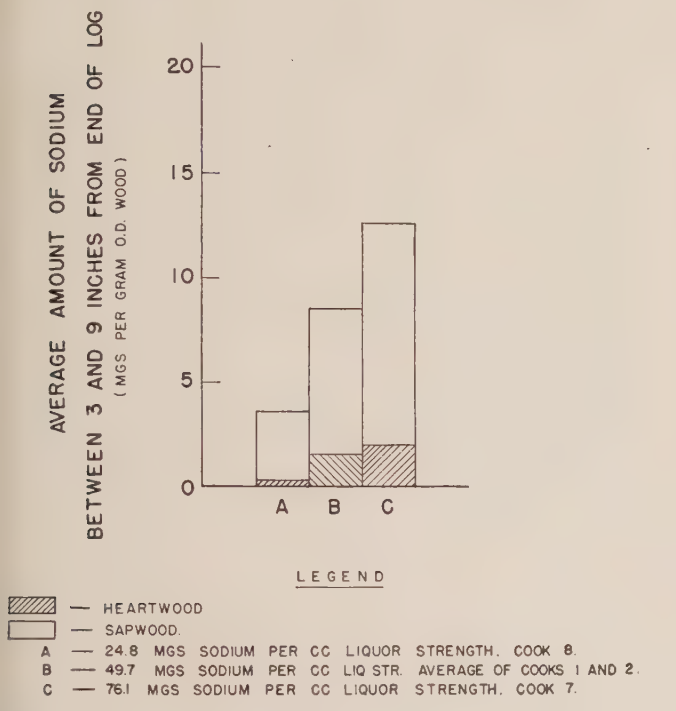

AVERAGE AMOUNT OF SODIUM
BETWEEN 3 AND 9 INCHES FROM END OF LOG
(MGS PER GRAM O.D. WOOD)
20
15
10
5
0
A
B
C
LEGEND
— HEARTWOOD
— SAPWOOD.
A — 24.8 MGS SODIUM PER CC LIQUOR STRENGTH. COOK 8.
B — 49.7 MGS SODIUM PER CC LIQ STR. AVERAGE OF COOKS 1 AND 2.
C — 76.1 MGS SODIUM PER CC LIQUOR STRENGTH. COOK 7.

Fig. 4. Effect of liquor concentration on penetration

between cook 8, cook 7, and averages of cooks 1 and 2, where the liquor strengths were approximately 25, 50, and 75 mg. sodium per ml., respectively. These cooks were all plain cooks in that neither pre-evacuation nor hydrostatic pressure was used. The results ran according to expectations; penetration appears proportional to liquor strength. However, the chemical concentration in the interior of the log is increased at a slower rate than that in the exterior parts of the log.

Effect of Use of a Wetting Agent

In cook 9A (also 9B) 0.05% of Triton N-100 (Rohm & Haas Co.) was added to the cooking liquor and the cook carried out using pre-evacuation and hydrostatic pressure as in cook 6.

Figures 5 and 6 give the comparison concerning the degree of liquor penetration in cooks 6 and 9A. A decided increase in penetration into both the sapwood and heartwood resulted from use of the wetting agent. Figure 6 shows that in cook 6, the average sodium content between 3 and 9 inches is approximately 18.3 mg. per gram of oven-dry wood, whereas in cook 9A, the average sodium content is about 23.0 mg. per gram of oven-dry wood. Figure 5 shows the favorable increase in penetration of the difficultly penetrated heartwood, particularly into the first few inches of the log.

As a further experiment, the effect of Triton N-100 in increasing penetration into conditioned yellow birch was investigated by determining the increase in moisture content of the wood when immersed in pure water and in an aqueous solution of the wetting agent. A number of $^3/_4$-inch cubes of both heartwood and sapwood, conditioned to a uniform moisture content of about 11%, were immersed in both distilled water and in a 0.05% solution of Triton N-100. After 4.25 hours of immersion, the samples were withdrawn and the new moisture contents determined. The following is a summary of the findings:

	Moisture content	
	After immersion in water	*After immersion in 0.05% Triton*
Sapwood	46.2%	76.5%
Heartwood	38.5%	51.2%

Apparently, the use of a suitable wetting agent results in improved penetration of water or neutral sulphite liquors.

Effect of Storage

It was decided to make a brief investigation to determine if the entrained chemicals tended to become more uniformly distributed in the log during a storage period. Accordingly, two logs were cut from a single 4-foot log and both cooked at the same time to eliminate any treatment variables. One log, referred to as cook 9A, was analyzed immediately, while the other, referred to as cook 9B, was stored for a period of 96 hours at room temperature before the analysis was carried out.

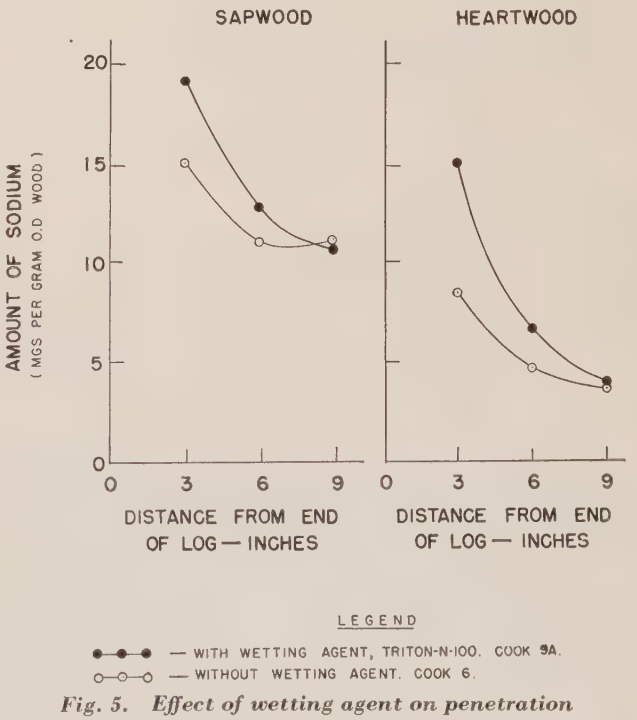


Fig. 5. Effect of wetting agent on penetration

The comparison of the two logs is shown in Fig. 7. The analysis of samples taken at 1.5 inches from the end was obtained for additional information. It is surprising that the expected tendency toward uniform distribution should show such slight progress after a

96-hour period. A slight migration of chemicals from the end of the log toward the center seems to have taken place but not to any pronounced degree. It will be observed that the redistribution of the chemicals is similar in both sapwood and heartwood. There is no evidence that the favorable aspects of storage are brought about, directly or indirectly, by an extensive redistribution of chemicals in the log. Quite possibly the continued beneficial chemical action, suspected of taking place during storage, would occur whether any

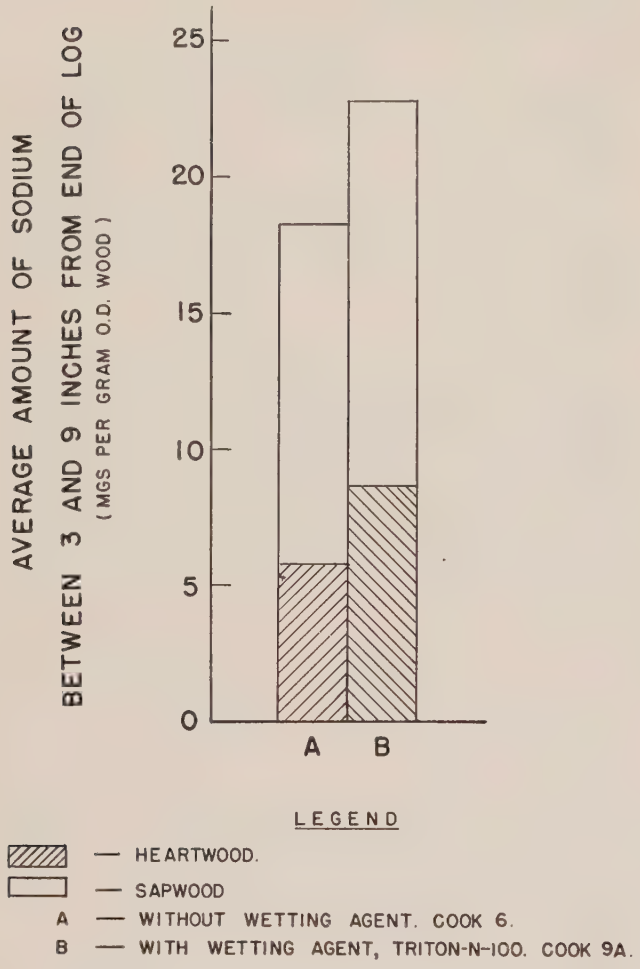


Fig. 6. Effect of wetting agent on penetration

extensive redistribution of chemicals took place or not.

It is evident from the shape of the solute distribution curves of all the cooks that the interior of the cooked logs receives much less chemical treatment than the areas near the ends of the log. Hence any successful method to equalize the chemical treatment throughout the log would be highly desirable. It might be possible to more nearly equalize the chemical content by sawing notches about two-thirds through the log, and perhaps 6 inches apart. This should not greatly weaken the log for grinding. If the slots were 1 foot apart, as might be more practical for a 4-foot log, almost all parts of the log would be only 6 inches distant from a cross-sectional surface.

Effect of Moisture Content

The concern over variations in moisture content of the logs and the attempt to keep these variations within reasonable limits, has been referred to previously in this report. An inspection of Table I will show that most cooks resulted in a "lopsided" penetration of the log, in that one end of the log was more heavily penetrated than the other. It was suspected that the difference in penetration was caused by a variation in the moisture content of the two ends. When the logs were stored in the drum, they were placed vertically on end and since most of the logs were originally quite wet, it is possible that gravity might have caused some moisture to shift from the top half of the logs toward the bottom. Nevertheless, it was deemed advisable to investigate the effect of moisture content on penetration by cooking a "wet" and a "dry" log. Accordingly, one log was immersed in water for about a week (sinkage took place in about 5 days after immersion). The dryest log available that was free of checks was obtained from a pile of partially seasoned unbarked logs. This log was debarked and then used as the "dry" log. The moisture content was calculated in the same manner as for all the other logs. The log referred to as cook 10A had a calculated moisture content of 81.3% and the log referred to as cook 10B had a moisture content of 58.7%. The two logs were cooked together without using pre-evacuation and hydrostatic pressure so that a comparison was possible with the average chemical penetration values of cooks 1 and 2.

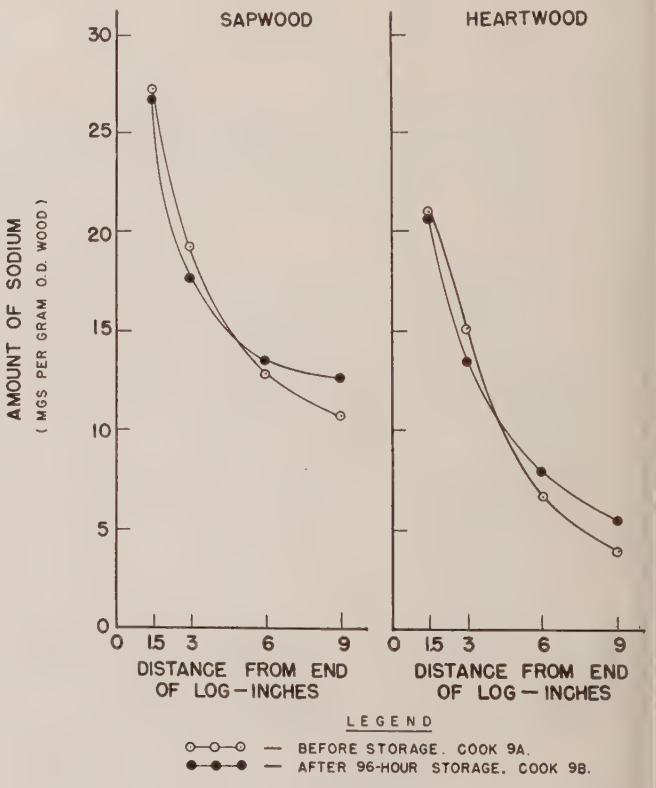


Fig. 7. Effect of 96-hr. storage on redistribution of penetrant within log

The results are shown in Figs. 8 and 9. The wet log was much less penetrated than the others, and the dry log was somewhat more penetrated than the intermediate moisture content log. Hence, it seems that above a moisture content of 58%, at least, the higher

the moisture content the more difficult the penetration of solute into the wood. It was not possible to check penetration of a log with a much lower moisture content than 58% because of the excessive checking taking place while drying out. It is suspected that there probably exists an optimum moisture content in the range between 30 and 40% which results in maximum penetration. If the wood is very wet, the moisture in the capillaries acts as a physical barrier to the mass motion of the solution, hence causing penetration to be accomplished mainly by diffusion. On the other hand, if the wood is quite dry, practically no moisture is available in the wood to allow the solute to enter by diffusion and penetration is almost entirely restricted to the "en masse" entrance of the solution. This is a slow process because of the resistance of the very fine capillaries and the presence of occluded air in the wood. It is conceivable then, that maximum penetration of solute will result at that moisture content where the sum of the two methods of penetration is the greatest.

SUMMARY AND CONCLUSION

1. Use of pre-evacuation of 23.5 inches of mercury for 45 minutes prior to cooking yellow birch logs in a neutral sulphite cooking liquor appears to result in a moderate improvement in the penetration of the cooking chemicals into the logs.

2. Application of a total pressure (steam + hydrostatic) of 200 to 225 p.s.i. during similar cooking treatments seems to greatly increase penetration into both the sapwood and heartwood.

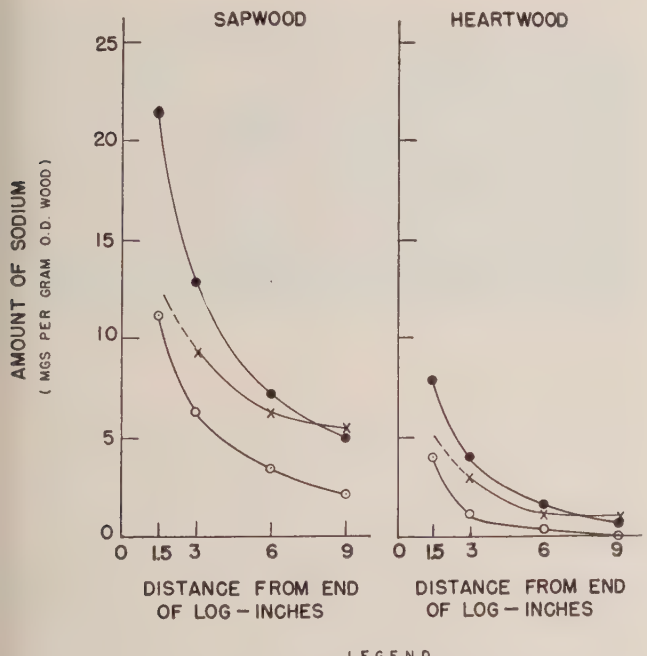


Fig. 8. Effect of moisture content on penetration

3. Application of hydrostatic pressure in conjunction with pre-evacuation treatment greatly increases penetration. This increase appears to be greater than the cumulative increase due to pre-evacuation and hydrostatic pressure when either of these treatments is used alone.

4. Increasing the chemical concentration of the cooking liquor results in an increase of the over-all chemical content in the logs. However, the increase is more pronounced near the end of the log (3 to 5 inches from the end) than in the interior sections of the log (6 to 9 inches from the end).

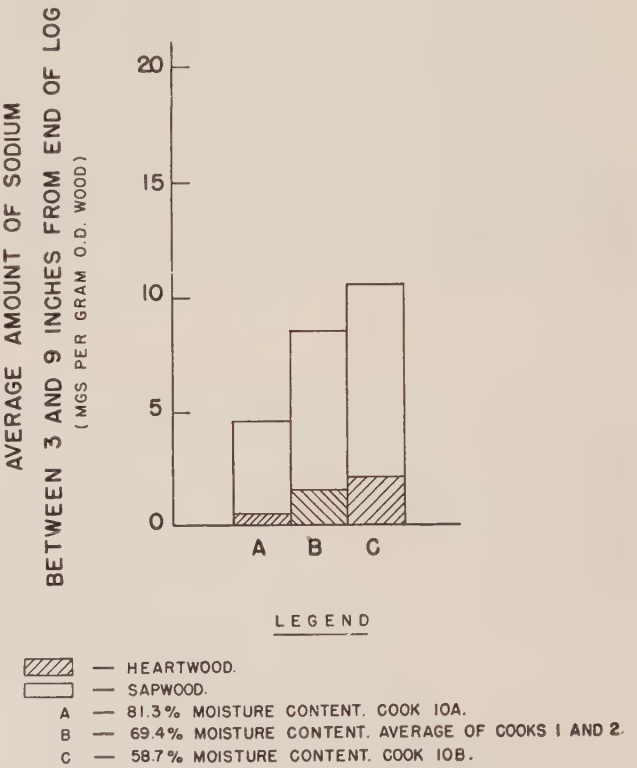

AVERAGE AMOUNT OF SODIUM BETWEEN 3 AND 9 INCHES FROM END OF LOG
(MGS PER GRAM O.D. WOOD)
20
15
10
5
0
A B C
LEGEND
— HEARTWOOD.
— SAPWOOD.
A — 81.3% MOISTURE CONTENT. COOK 10A.
B — 69.4% MOISTURE CONTENT. AVERAGE OF COOKS 1 AND 2.
C — 58.7% MOISTURE CONTENT. COOK 10B.

Fig. 9. Effect of moisture content on penetration

5. Use of the wetting agent, Triton N-100, as a component of the cooking liquor, results in a definite increase in the penetration of cooking chemicals into yellow birch logs. Penetration of water into well-seasoned sapwood and heartwood of yellow birch wood is greatly aided by adding 0.05% Triton N-100 to the immersion water even at normal temperatures and pressures.

6. Storage of a cooked log for 96 hours at room temperature results in a slight migration of the chemicals entrained within the log. The redistribution of the chemical content is effected by a shift of the chemicals from the more heavily penetrated portion near the ends of the log to the less heavily penetrated section in the interior of the log.

7. Above a 58% moisture content, the higher the moisture content of the log the more the penetration of cooking chemicals into the log is retarded. This effect is quite pronounced when the moisture content exceeds 80%.

Received Feb. 23, 1950. Presented at the Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 20–23, 1950. An abstract of a thesis submitted in partial fulfillment of the requirements of the New York State College of Forestry, Syracuse, N. Y. for the degree of Master of Science.

Neoprene Latex in the Paper Industry

R. H. WALSH, H. H. ABERNATHY, W. W. POCKMAN, J. R. GALLOWAY, and E. P. HARTSFIELD

The paper industry is familiar with elastomer latices mainly as saturants and adhesives and has not considered them as pulp additives except in a few cases where relatively large amounts of elastomer have been added at the beater to produce imitation leather-type products. Recently it has been found that paper made from pulp properly treated with small amounts of Neoprene Latex Type 735 possesses a highly desirable combination of properties. Further, this latex can be used in larger percentages to produce products similar to those produced by saturation. The latex is added to the pulp by an exhaustion procedure. Details of the process are described. Data illustrating the high wet strength, good dry strength, folding endurance, and other properties of the neoprene treated paper are given.

RECENT investigation has revealed many similarities between paper and elastomers which are not apparent on casual examination. Both are polymeric materials and both exhibit a combination of elastic and plastic properties when subjected to strain (*9*). This suggests that if the two types of polymers could be properly combined, a new class of products having unique and useful properties might result. Broadly speaking, it is possible to produce two types of such products: (1) those in which the continuous phase, particularly on the surface, is elastomeric; and (2) those in which the continuous phase is cellulosic.

The first attempts to prepare products of the first type were made by Hancock (*2*) in 1824. He suggested the waterproofing of paper by immersion in a dilute solvent solution of rubber. This treatment also resulted in an improved resistance to tearing. These early experiments failed to influence the papermaking art since the quality of the rubber was poor and practical application methods were lacking. Almost a hundred years later, methods were developed for stabilizing natural rubber latex so that it could be shipped from the plantations to manufacturing centers and arrive in a usable form. Today numerous products of the type described by Hancock are produced using latex, either natural or synthetic, in place of the solvent solutions that he employed. From a papermaker's standpoint, however, it is scarcely allowable to classify such products as paper.

Kaye (*5*) was apparently the first to recognize the possibility of using rubber latex in combination with paper pulp to produce products in which cellulose is the continuous phase. A number of trials were made, but most of them failed because of the clogging of wires and felts. In the years since this first work appeared, a number of patents have been issued which claim successful addition to natural rubber and other latices to pulp at the beater. In general, the examples shown in these patents deal with the addition of 10 to 15%, or even more, of latex to produce a soft, leatherlike material. Today, large quantities of imitation leather are produced from combinations of paper and latex. Except in a few cases where beater addition* technique is used, the products are made by saturating either a dry or a wet web. The surprising effects which can be obtained by the addition of smaller percentages (1 to 5%) of the proper type of a synthetic latex to the pulp at the beater have not been widely recognized. The use of neoprene in small amounts as a beater size results in paper having excellent wet strength, increased dry physical properties, improved impact strength and energy absorption, softness, sizing, and many other desirable characteristics.

NEOPRENE LATEX

The neoprene discussed in this report is Neoprene Latex Type 735 which is an alkaline, aqueous dispersion of polymerized 2-chlorobutadiene 1,3. It has a pH of about 12 and a total solids content of approximately 35%. Electron microscope pictures (Figs. 1 and 2)

Fig. 1

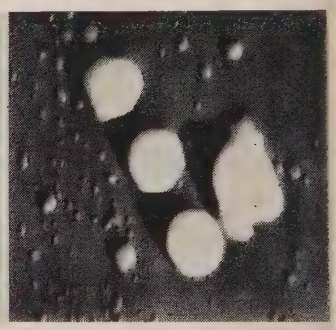


Fig. 2

show that the neoprene particles are small spheres averaging about 120 mu in diameter. They range in size from 20 to 220 mu (Fig. 3) and are in rapid Brownian motion. One milliliter of an 8% suspension of such particles would contain over 50,000,000 individuals (*1*)—a graphic illustration of the smallness of the individual latex particle. The neoprene particles are tacky even at room temperature. Hofrichter and McLaren (*4*) and McLaren and Seiler (*7*) have indicated the importance of the existence of a threshold tack temperature in their discussion of adhesive bonds. The neoprene molecule contains polar chlorine atoms. This may account for its well-known excellent adhesion to cellulosic materials since McBain and Lee (*6*) have shown that the introduction of polar groups into a molecule increases adhesive strength. Neoprene Latex Type 735 contains no vulcanizing agent or antioxidant, yet these

R. H. WALSH, H. H. ABERNATHY, W. W. POCKMAN, J. R. GALLOWAY, and E. P. HARTSFIELD, Rubber Laboratory, E. I. du Pont de Nemours & Co., Wilmington, Del.

* The term "beater addition" or "added at the beater" is used in this paper to refer to additions at some stage in stock preparation prior to the fan pump. Preferably, in the case of neoprene, addition is at some stage where stock consistency is above 3%.

materials are essential if the best properties are to be obtained. As a consequence, at least 5 parts of zinc oxide and 2 parts of a good antioxidant per 100 parts of neoprene must be added to all paper containing neoprene. The antioxidant, n,n′di-beta-naphthyl-paraphenylenediamine, has been found most generally useful.

THEORY

In considering the problem of latex addition to pulp, it was assumed that the best results would be obtained if the neoprene particles were uniformly deposited on the fibers in such a manner that normal fiber-to-fiber bonding was not greatly affected. This should result in the formation of a maximum number of neoprene-cellulose bonds and a minimum interference with sheet formation or machine operation. It is apparent that in order to meet this condition, the colloidal properties of the system, latex plus pulp, must be so adjusted that the latex and pulp can be intimately mixed without immediate precipitation of either of them, and that upon addition of coagulating agent, there should be a minimum of neoprene-to-neoprene flocculation. Both alkaline

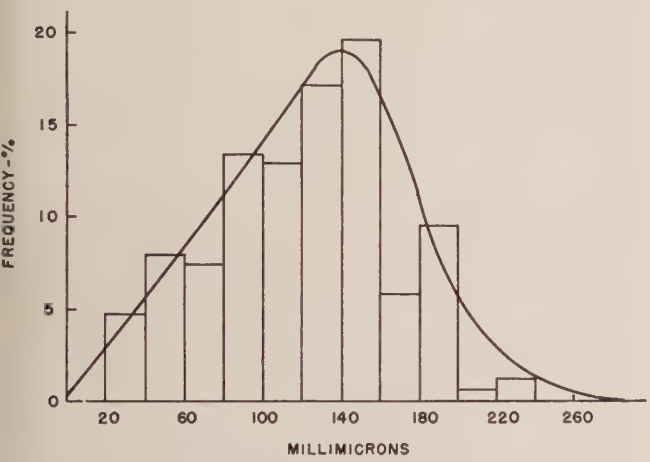


Fig. 3. Particle size distribution of neoprene

cellulose fibers and Neoprene Latex Type 735 carry negative charges on their individual particles. Thus, if the two were mixed, there should be no immediate instability, and the first condition outlined above would be met. The second requires as great an affinity as possible between an individual neoprene particle and a cellulose fiber and, further, that the neoprene be coagulated as discrete particles rather than as a mass. Normally, the negatively charged neoprene particles are coagulated in mass on addition of even small amounts of positively charged electrolytes. The mechanism involved is probably that the first positive ions which enter the system cause collapse of the Gouy double layer on the particles. Additional quantities of ions probably cause complete desolvation of the particles resulting first in flocculation and then in coagulation. Thus, if an electrolyte such as aluminum sulphate is added even as a dilute solution to neoprene there is immediate massive coagulation (Fig. 4). However, it is known that both dilution and the addition of compounds containing hydrophilic groups tend to increase the stability of colloidal systems. Tests showed that the addition of dispersing agents of the formaldehyde-sodium naphthalene sulphonate condensation product class plus dilution is an efficient method for increasing the stability of neoprene. Under these conditions, titration of the latex with an aluminum sulphate solution produces small, uniform particles instead of massive coagulation (Fig. 5). Furthermore, experience showed that if the

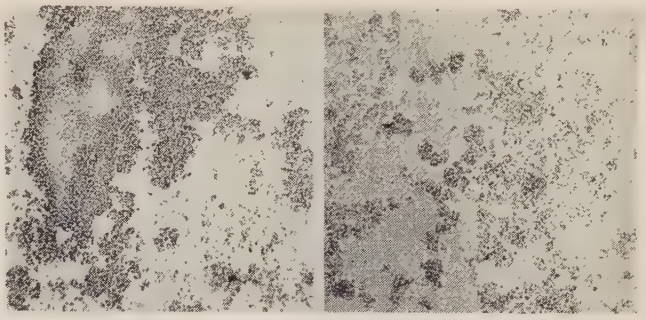


Fig. 4 *Fig. 5*

stabilized and diluted latex were sensitized to coagulation by adding a small amount of aluminum sulphate to it before mixing with pulp, better results were obtained. There is some evidence that during sensitization a hull composed of the reaction product of aluminum and formaldehyde naphthalene sodium sulphonate was formed.

In studying electrolytes to be used for sensitization and for final coagulation, the Hardy (*3*) and Schulze (*8*) rule was found to apply and the trivalent aluminum ion from aluminum sulphate was found to be the most suitable.

The difference in the effect of coprecipitating unadjusted 5% neoprene with kraft pulp and a similar experiment using a 5% sensitized latex (one containing 6 parts dispersing agent and 0.75 part alum per 100 parts of neoprene) is readily apparent by comparing Fig. 6 with Fig. 7. Figure 6 shows the effect of pre-

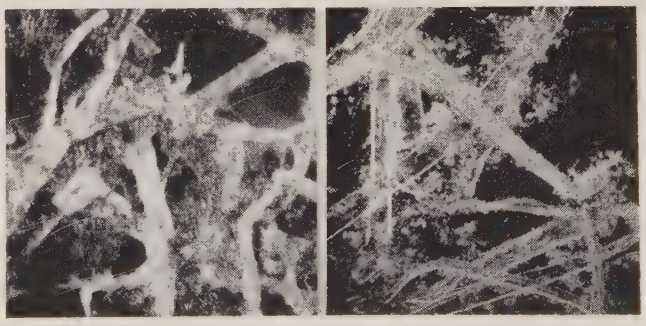


Fig. 6 *Fig. 7*

cipitating with alum 10 parts, dry basis, of unadjusted neoprene onto 100 parts, dry basis, of kraft fiber. Figure 7 shows the effect of precipitating with alum a similar mixture of sensitized latex and kraft fibers. It will be noted that Fig. 7 shows conclusively that when the sensitized latex was used, the neoprene is present on the fibers as discrete particles and not in a manner

that would cause serious collapse of the fibrils on the beaten pulp. A few tests were carried out to show how the neoprene exists in the dried sheet. Experiments established that it was possible to stain selectively the neoprene by use of the oil-soluble dye Sudan III.

Photographs of microtomed cross sections were prepared, and an examination of these pictures shows that the neoprene particles have coalesced during sheet drying and are present in the sheet more or less as a continuous layer on the fibers.

LABORATORY WORK

These preliminary experiments demonstrated the desirability of studying in some detail the effects to be obtained by the use of small amounts of neoprene. An investigation of the effects of neoprene addition on sheet properties, particularly wet strength, and the influence of operating variables such as pH, time and temperature of drying, and type of furnish on this property are most conveniently shown by hand sheets since the variables can be more easily controlled under laboratory conditions. The following procedure was developed as a standard for these laboratory experiments:

1. Preparation of Pulp—The pulp being studied was beaten to the desired Canadian freeness at 3% consistency in a 12-pound Valley beater. The roll was then raised and the pH adjusted to 8.5 with sodium hydroxide.

2. Addition of Zinc Oxide-Antioxidant Dispersion—In order to insure uniform distribution of the zinc oxide and the antioxidant required in conjunction with the neoprene latex, a dispersed masterbatch was prepared by wet grinding for 24 to 48 hours in a pebble mill in the presence of a dispersing agent and protective colloid according to the following formula:

50% Zinc Oxide-Antioxidant Dispersion

Zinc oxide	100
Antioxidant	40
10% Dispersing agent solution	30
10% Ammonium caseinate solution	30
Water	80

Sufficient quantity of this dispersed masterbatch was added to the pulp in the beater to incorporate 5 parts of zinc oxide and 2 parts of antioxidant per 100 parts of the neoprene being used in the experiment.

3. Addition of Sensitized Latex—It was found that it was best to add the sensitized latex at 5% solids. The sensitized latex was prepared as follows: Neoprene Latex Type 735 was first treated with sufficient 5% alkaline, aqueous solution of the formaldehyde naphthalene sodium sulphonate to introduce 6 parts of the dispersing agent per 100 parts of neoprene. Sufficient water to produce 10% neoprene solids was then added. This was followed by enough water containing aluminum sulphate to produce a final latex containing 5% neoprene and 0.75 part alum per 100 parts of neoprene. This sensitized latex should have a pH of 8.3 ± 0.2 and the amount of alum required should be that which produces this degree of alkalinity.

4. Final Step in the Beater—After the sensitized latex was added, two minutes were allowed for thorough mixing. Sufficient 5% alum solution was then added to reduce the pH to 4.5. The mix was then dumped from the beater.

5. Preparation of Handsheets—The stock was diluted to 0.1% consistency and sheets made on a square 8 by 8-inch Williams sheet mold. The sheets were pressed twice under a pressure of 100 p.s.i. for a total time of 25 seconds. They were then dried between filter papers on a steam-heated drum drier at 180°F. under a felt web.

6. Method of Testing—All samples were conditioned at 75°F. and 50% relative humidity for 24 hours before testing. A 1 by 7-inch tensile test specimen was used. They were broken on an L-5 Scott Tensile Tester in accordance with TAPPI Method T-404 m-47. Bursting and tearing strengths were measured in accordance with T-403 m-47 and T-414 m-42, respectively. In general, sheet weights were controlled as closely as possible to 70 pounds (25 × 38—480) and test values were converted to 100 pounds basis weight. Unless otherwise stated, water immersions were for 24 hours at 75°F.

The most striking observation from the laboratory experiments carried out according to the procedure outlined above is the high wet tensile strength exhibited by the handsheets containing small percentages of neoprene. The first laboratory experiments were carried out on kraft pulp beaten to a Canadian freeness of 550. The data plotted in Fig. 8 show the effect on the wet tensile strength produced by varying the concentration of neoprene in the sheet. The data for the abscissa (per cent neoprene in the sheet) in this figure as well as for all of the other figures on the various properties of the handsheets were obtained by analysis of the finished paper. Throughout the range studied, increasing the concentration of neoprene results in an increase in the per cent tensile strength retained after immersion in water. A range of neoprene concentration of 1 to 3% appears to be particularly worthy of further study.

Fig. 8

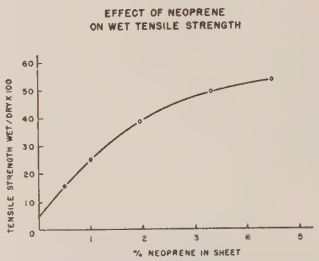
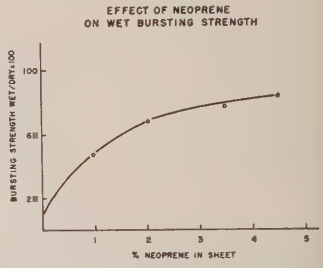


Fig. 9



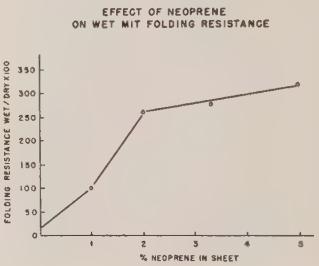


Fig. 10

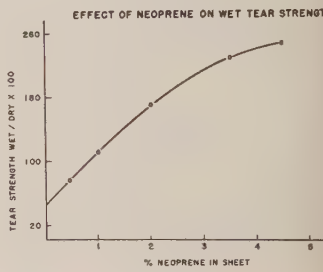


Fig. 11

As might be expected, wet bursting strength (Fig. 9) also increased with increasing neoprene concentration. The fact that the retention of bursting strength is higher than that of tensile strength is believed to be due to the higher wet and dry elongations imparted to paper by neoprene since it is known that bursting strength is directly affected by elongation according to the following relation:

$$\text{Bursting strength} = K\ (\text{Tensile strength})\ (\sqrt{\text{Elongation}})$$

Both the folding and tearing resistance of neoprene treated papers are higher wet than dry as are shown by the data plotted in Figs. 10 and 11, respectively.

Tests showed that drying temperature variations within the range of 160 to 190°F. have little effect on the ultimate wet-strength development of neoprene-treated paper. The higher the drying temperature, the quicker the development. However, in any event, 80

to 85% of the ultimate wet tensile strength will be developed within 24 hours after sheet drying and all of it within 10 to 14 days.

The pH of the stock during sheet formation appears to have little effect on the wet strength (Fig. 12). This allows preparation of wet-strength papers at almost any desired extracted pH even as high as 8.5. To study this effect the neoprene-pulp slurry was first precipitated at pH 4.5 with alum in the usual fashion. The system was allowed to remain at this pH until equilibrium was established. The pH was then adjusted to the desired point and the sheet formed and dried. Sodium aluminate can be used to adjust pH up to about 6.8. Above pH 7, sodium hydroxide can be used. However, the neoprene-treated stock should not be allowed to age in the alkaline condition excessively since prolonged alkaline aging of the wet-treated pulp seriously retards wet-strength development.

The degree of pulp hydration appears to have only a slight effect on the wet-strength development of neoprene-treated sheets. In the laboratory, a 60:40 mixture of Canadian and Swedish kraft was beaten to various degrees of freeness (700, 500, 300, and 150 ml. Canadian) and treated with neoprene. Tensile-strength retention after water immersion was slightly higher for the highly beaten stock, but all of the values were in the same range (Fig. 13). When bleached sulphite was tested under similar conditions, results paralleled those obtained with the kraft.

Fig. 12

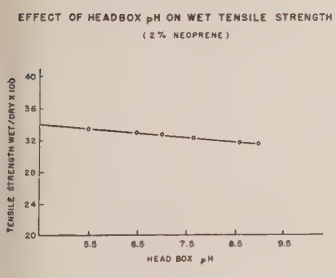
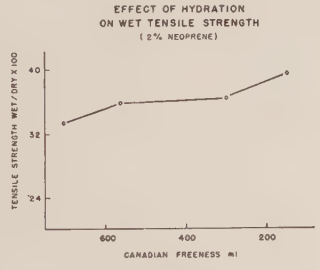


Fig. 13



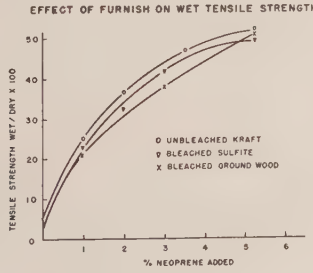


Fig. 14

Laboratory experiments show that the neoprene can be used equally well with the ordinary types of kraft, sulphite, and groundwood. However, the actual wet strength obtained will be influenced by many factors including furnish history. The effect of neoprene on the wet strength of sheets made from a 700 Canadian freeness bleached sulphite stock, a bleached groundwood stock, and a 550 Canadian freeness unbleached kraft stock is shown in Fig. 14.

MILL EXPERIENCE

Wet Strength

Many mill trials using neoprene latex as a pulp additive have been made. The results obtained have generally been in good agreement with those predicted from laboratory work. Figure 15 which shows the distribution of wet-strength values obtained in 25

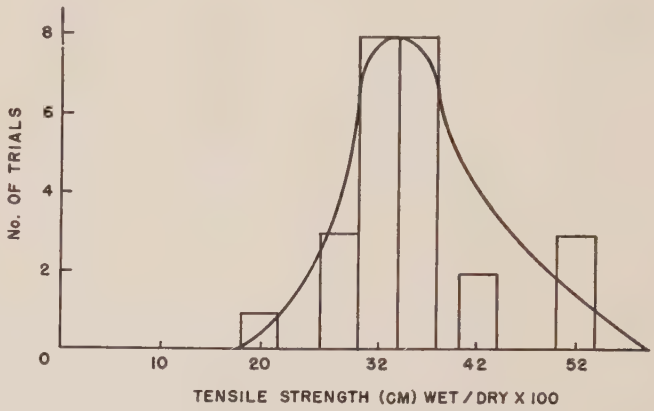


Fig. 15. Distribution of wet tensile strength retention for 25 factory trials

average machine runs (2% neoprene added) in various localities indicates the good degree of agreement and, also, a high degree of reliability for the neoprene treatment. The chart shows, however, that some poor and some exceptionally good results were obtained. This led to a study of operating variables which might affect development of expected physical properties, particularly wet strength. A condition which was observed to adversely affect results was the presence of excessive amounts of electrolytes in the water used for stock preparation. Electrolytes, as might be predicted, change the latex and fiber particle charges as well as their surface characteristics. This apparently results in premature latex flocculation and, in turn, poor retention of the neoprene and relatively poor wet strength. The sulphate ion has been the usual offender in mill work. It has been observed that in cases where exceptionally good results were obtained, the pulps used were well washed, the water used in stock preparation was low in electrolytes, and machine speeds were relatively slow. There are without doubt other factors which affect efficiency which remain to be studied. However, the very good results obtained in isolated cases indicate the probability of future attainment of exceptionally high efficiency.

It may be of interest to examine the results of some other machine runs utilizing different furnishes. These are outlined in Table I.

Although the lack of uniformity in basis weight of the resulting paper together with the fact that no single concentration of latex was present prevent any direct comparison of the efficiency of the treatment in the various furnishes, nevertheless the data show conclusively that, in all cases, the use of neoprene latex has resulted in production of paper having high wet tensile strength.

Chemical Resistance

While wet strength is a major property introduced by neoprene it also imparts other properties which are of a great deal of interest. For example, it has been found that neoprene-treated papers retain a considerable portion of their physical properties after immersion in solutions of acids, bases, and other chemicals. The solutions and concentrations used were chosen arbitrarily. However, it is believed that they may indicate possible uses for neoprene-treated papers in packaging.

Table I. Effect of Neoprene Latex Type 735 on Wet Tensile Strength

Parts neoprene added per 100 parts pulp	*Furnish*	*Basis weight*	*Tensile strength, wet/dry × 100*
1	Bleached kraft	30	32.1
2	Bleached kraft	50	38.4
5	Bleached kraft	70	47.4
5	Bleached rope	70	56.3
10	Bleached rope	100	92.0
2	Bleached sulphite	14	29.8
2	Rag	100	40.0
10	Rag	100	64.0

Table II. Resistance of Neoprene-Treated Papers to Chemical Solutions

Solution	*Tensile strength, wet/dry × 100* 2% neoprene	5% neoprene	*Tear resistance, wet/dry × 100* 2% neoprene	5% neoprene
10% Diethanolamine	18	29	145	165
5% Hydrochloric acid	17	26	72	90
5% Sulphuric acid	17	27	172	190
5% Nitric acid	14	25	110	135
5% Phosphoric acid	27	40	120	160
3% Citric acid	23	29	125	150
5% Sodium hydroxide	18	30	100	125
5% Sorbitol	29	48	165	200
5% Synthetic detergent[a]	16	24	100	125
5% Ivory soap	16	23	90	120
25% Glycerine	42	49	150	210
Water	36	45	175	240

[a] A sodium aliphatic sulphonate.

Unbleached, 550 Canadian freeness kraft sheets of 60-pound basis weight were tested. They were immersed in the solutions for 24 hours.

Although immersion for 24 hours in most of the chemicals tested has produced a greater loss in tensile strength than a corresponding exposure to water, nevertheless the effect of these chemicals on neoprene-treated papers is far less than for untreated papers. These results indicate possibilities for the utilization of neoprene to produce paper requiring chemical resistance. Longer exposure tests, particularly in the case of the acidic solutions, would undoubtedly be required to fully establish their practicality.

Other Sheet Properties

The use of neoprene latex results in an improvement in many other properties of the sheet besides the increase in wet strength already discussed. The effect on some of the most commonly measured properties of paper is illustrated in Table III, while Table IV gives the results of some of the more specialized types of tests.

Probably the most striking effect shown by these data is the marked increase in elongation imparted to all of the different types of paper through the incorporation of neoprene. The tensile and bursting strengths of glassine and kraft specialty paper were improved by about 25%, whereas with kraft bag paper the improvement was of the order of 10 to 15%. Resistance to tearing was as good as the control in all cases except in kraft specialty paper. In every case, folding endurance was markedly improved.

All of the properties measured were appreciably improved through the incorporation of neoprene and, in all cases, the improvement obtained was greater with the 5% than with the 2% addition.

Another property of paper, which is of considerable interest to papermakers, is internal bond strength. This property, together with others such as smoothness and gloss, must be considered when producing papers to be printed or coated. The strength of the internal bond was measured using a modification of a procedure suggested by Sutermeister (*10*). In this test two round brass plates, each having an effective surface area of 1 square inch, are cemented to opposite sides of a paper specimen which has been preconditioned for 24 hours at 75°F. and 50% relative humidity. The finished assembly is held under the same conditions for an additional hour, and the paper is then tested by separating the plates at a rate of 1 inch per minute in a Tinius Olsen testing machine. Internal bond strength is recorded directly on the dial as pounds per square inch. The effect of varying the concentration of neoprene on the internal bond strength of paper produced from a furnish consisting of 75% semibleached kraft and 25% bleached soda is illustrated by the graph in Fig. 16. It will be noted that throughout the range studied the internal bond strength is progressively improved by increasing the quantity of neoprene used.

Table III. Effect of Neoprene on Various Properties of Paper

Type of paper	*Neoprene content, parts/100 parts pulp*	*Basis weight, lb.*	*Tensile strength, lb./in. width* m	cm	*Elongation, %* m	cm	*Bursting strength, points*	*Tear resistance, g.* m	cm	*Folding endurance, MIT* m	cm
Kraft specialty	0	60	46	26.2	1.7	3.8	63	165	183	1100	500
	2	58	55.8	32	2.3	5.6	81	139	153	3450	1500
Kraft bag	0	60	46	24	1.9	4.2	60	150	166	550	...
	2.5	59	48	26	2.5	5.6	65	164	174	1200	...
Kraft crepe (contains 1% wax)	0	90	31.5	21.5	6.0	3.8	65	232	284	...	...
	4	90	35.2	22.6	7.7	5.1	65	224	278	...	...
Glassine (calendered)	0	30	32	15	1.8	4.2	31	23	22	350	528
	3	29.5	40	19.5	2.4	6.2	41	26	21	1100	3100

Addition of Large Percentages of Neoprene

The major emphasis of this paper has been on the effect of treating pulp with small percentages of neoprene. However, experience has shown that amounts of neoprene in the range of 15 to 50 parts per 100 parts of pulp can be added by the techniques described. Very suitable products of the imitation leather type have resulted. These products have reflected the well-known high-strength, oil resistance, and excellent aging of neoprene. They have excellent cutting and embossing or molding characteristics. Some properties of a typical sheet containing a high percentage of neoprene are outlined in Table V. This sheet was made from unbleached kraft and had a basis weight of 132 pounds. It contains 17% neoprene.

This sheet was dense but flexible and could easily be embossed. Tensile strength is not unusually high but bursting strength, wet-bursting strength, folding endurance, and sizing have been greatly improved over values normally expected for a sheet of this weight.

Energy Absorption

In recent years it has become increasingly evident that the usual types of tests which have long been employed are not sufficient to give a complete picture of the properties of the finished product. One of the results of these considerations has been a realization of the importance of energy measurements in the testing of paper. It has been noted previously that neoprene-treated papers have considerably higher elongation without loss in tensile strength than untreated control papers. Steenberg's (*9*) concept of paper strength as related to stress-strain properties indicates that increased elongation should result in a marked improvement in the ability of a paper to absorb energy. Preliminary tests have indicated that neoprene-treated paper will absorb more energy than untreated paper whether the absorption is measured at comparatively low rates of loading, as in area under stress-strain curve measurements, or at higher rates of loading, as in impact resistance testing. The improvement is particularly pronounced at high rates of loading. These properties are especially important in the packaging and structural paper fields and, therefore, are of great potential interest.

Table IV. Properties of Kraft Specialty Paper Treated with Neoprene

Neoprene added, parts/100 parts pulp	*Basis weight, lb.*	*Sizing, min.*	*Edge tear, g.*	*Bekk smoothness, sec.*		*B & L gloss, %*		*Scuff resistance, md*	*Gurley porosity (100 cc.), sec.*
				wire	*felt*	*wire*	*felt*		
0	60	8	2135	12	10	6.1	6.0	1700	52
2	58	90	2450	17	19	7.2	6.7	6000	105
5	60	360	2775	19	20	7.8	7.8	12000	215

Sizing test was done by TAPPI Method T-433 m-44 and is given in minutes. Edge tear testing was by the Finch Method T-470 m-47 and is reported in grams. Scuff resistance tests were paper-to-paper under 1 kilo load.

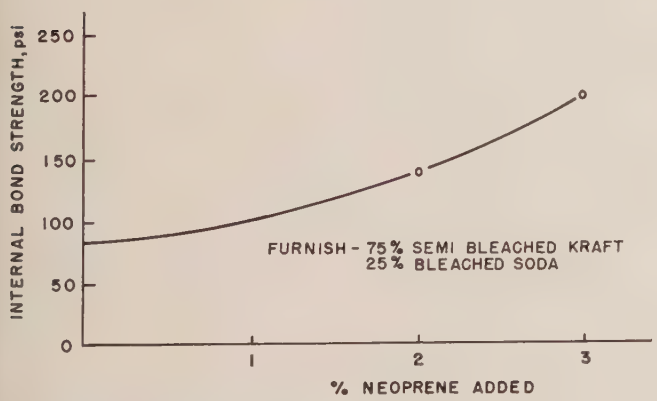


Fig. 16. Effect of neoprene on internal bond strength

SUMMARY

A practical method for adding Neoprene Latex Type 735 to the beater to produce paper of unusual properties is described. The method consists of sensitizing the latex with a dispersing agent and a small amount of aluminum sulphate. The sensitized latex, together with antioxidant and zinc oxide, is added to the pulp during stock preparation and is coprecipitated with the fiber by means of alum. The papermaking operation is then completed in the normal manner. The results of both laboratory experiments and plant trials using this process are given. Data are presented showing the effects obtained on various physical properties of the resulting paper. The wet strength of the paper is outstanding and coupled with the other properties described indicates that this process should be of great commercial importance.

Table V. Physical Properties of Sheet

Property	*M*	*MC*
Tensile strength, lb. in width	98	54
Elongation, %	4.5	14
Bursting strength, points	201	
Bursting strength, wet/dry × 100	92	
Folding endurance, MIT	9900	8400
Sizing—TAPPI Method T-433 m-44	No penetration after 45 days	

LITERATURE CITED

1. Albright, R. W., and Lees, R. A., "Colloid Chemistry," Alexander, J., 6, 350, Reinhold, N. Y., 1946.
2. Hancock, T., *BP* 5045 (1824).
3. Hardy, W. B., *Z. Physik. Chem.* 33: 385 (1900).
4. Hofrichter, C. H., Jr., and McLaren, A. D., *Ind. Eng. Chem.* 40: 329 (1948).
5. Kaye, F., *India Rub. J.* 67: 233 (1924); *India Rub. World* 68: 418 (1923).
6. McBain, J. W., and Lee, W. B., *Proc. Roy. Soc.* A 113: 606 (1927).
7. McLaren, A. D., and Seiler, C. J., *J. Polymer Sci.* 4: 63 (1949).
8. Schulze, H., *J. Prakt. Chem.* 25: 431 (1882); 27: 320 (1883); 32: 390 (1885).
9. Steenberg, B., *Pulp Paper Magazine Canada*, 50, No. 3: 207 (1949).
10. Sutermeister, E., Private communication.

Received Jan. 25, 1950. Presented at the Annual Meeting of the Technical Association of the Pulp & Paper Industry, New York, N. Y., Feb. 20–23, 1950.

Deinking Studies IV.

Selective Screening and Refining as Applied to Partially Deinked Stock

H. P. BAILEY, J. J. FORSYTHE, and J. F. TOMASZEWSKI

Experiments previously made in a commercial deinking system have indicated that the major part of the defibering and deinking has been obtained during the initial disintegration in an impeller-type centrifugal pulper. Further work conducted on a semicommercial scale has shown that it is possible to take the partially deinked and defibered stock from the centrifugal pulper and by selective screening with Jonsson screens to separate deinked and defibered fractions which may be run directly to brown stock washers, thereby eliminating the normal cooking procedure or making it necessary on a relatively small part of the total stock only. It has further been indicated that by a combination of selective screening and of disintegration with a high-speed refiner that elimination of the cooking process may also be nearly affected. Brown stock thus produced has been semicommercially bleached in the usual manner with no detrimental effect on the cleanliness or other properties of the deinked stock so far as can be determined experimentally.

It has already been found (*1*) that in a mill production deinking system 77% of deinking and defibering has been accomplished during initial disintegration and only 21% during subsequent cooking. This work immediately suggested the possibility of savings in steam and power by selecting the deinked portions which have been completely defibered during the initial disintegration and sending these directly to the brown stock-washing operation. At the same time it should be possible to eliminate and return for further treatment those portions of stock which have not been defibered in the primary operation or to send these fractions to the cooking operation.

An investigation was therefore undertaken to ascertain whether or not this selective principle of separating defibered and nondefibered, deinked stock could be carried out on a semicommercial basis.

LABORATORY EQUIPMENT AND METHODS USED

The pulp classifier used consists of a series of interchangeable rectangular screens of different meshes stacked vertically upon and clamped to a base. A pulsating diaphragm in the base keeps the stock agitated on the screens. In operation the screens are flooded with water. A measured quantity of stock, diluted to approximately 0.015% consistency, flows into the top of the screen stack and settles onto and through the screens. The quantity of stock retained on each screen is weighed, moisture-free, and computed as a percentage of the original stock. The stock passing through the finest screen is measured by difference.

For this investigation, a screen series has been selected experimentally to provide good distribution of fractions in all phases of the deinking system. The screens used are 4, 10, 14, 20, 35, 42, 65, 100, and 170-mesh.

Composite samples of stock, taken over an adequate period of time and representative of the stock at that point and time, were obtained at each phase of the experimental process and also at comparable points on the commercial deinking system.

Classification tests were run on each sample taken. The fractions were computed individually and then combined into the following three fractions.

1. Coarse—those fractions retained on the 4, 10, 14, and 20-mesh screens.
2. Medium—those fractions retained on the 35, 42, 65, and 100-mesh screens.
3. Fine—those fractions retained on and passing through the 170-mesh screen.

To supplement the information obtained by classification, the tested samples were also examined and compared for cleanliness by visual comparison, for freeness, ash, consistency, chlorine number, brightness, and strength. Only those results which are considered significant are included in this report.

PRODUCTION AND EXPERIMENTAL SYSTEMS

The production system used for the commercial deinking is shown by the flowsheet in Fig. 1. Initial

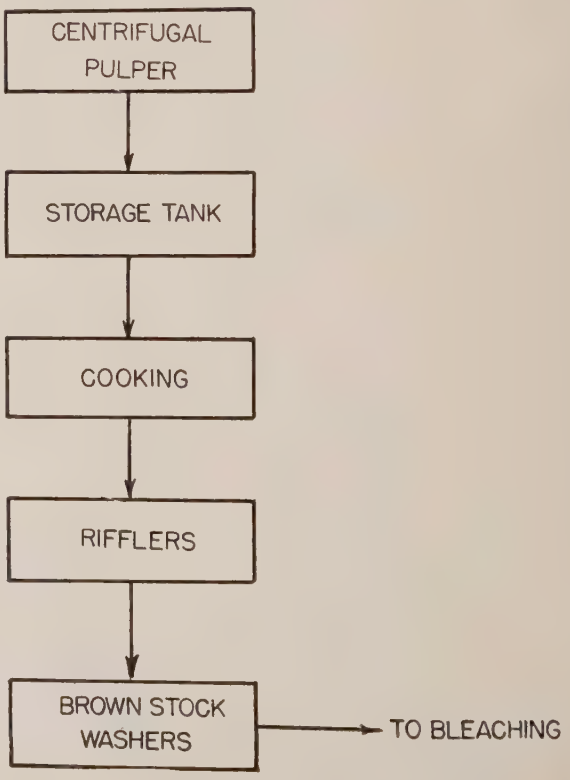


Fig. 1. Flow sheet of mill deinking system

H. P. Bailey, Member TAPPI, Manager; J. J. Forsythe, Member TAPPI, Technical Superintendent; and J. F. Tomaszewski, Assistant Chemist, International Paper Co., Niagara Falls, N. Y.

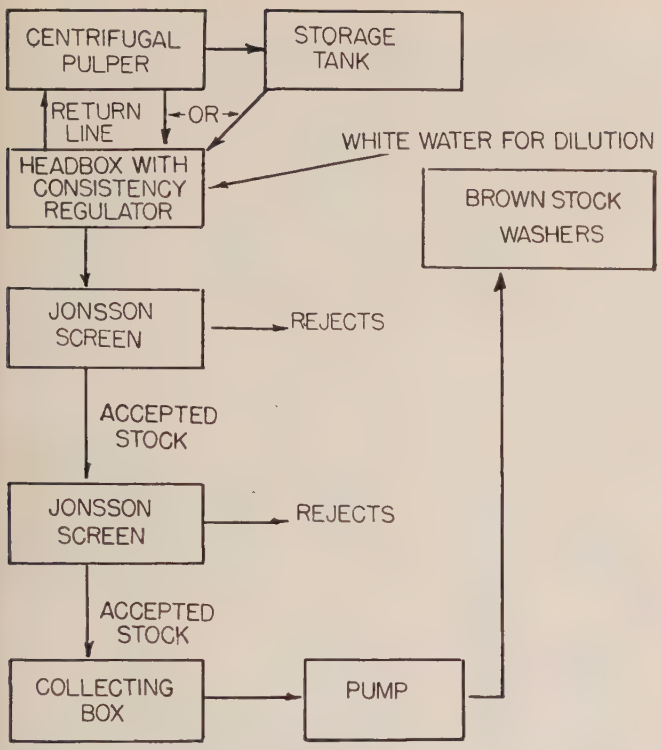


Fig. 2. Flow sheet of experimental system with two Jonsson screens

disintegration takes place continuously in an impeller-type centrifugal pulper. Waste paper, alkali, and heated white water are fed into the pulper. After partial deinking and defibering the stock is treated in stationary cookers equipped with circulating systems. The cooked stock is then diluted with white water and is riffled to remove heavy material and coarse trash. Finally the brown stock is washed on couch-type, multiple-cylinder unit washers and is bleached.

In the experimental work two different methods of treatment were employed: first, the application of selective screening alone to the waste paper stock coming from the centrifugal pulper; and second, selective screening and then disintegrating the accepted screened stock with a high-speed refiner.

The selective screening process is given in the flow-sheet in Fig. 2. The partially defibered and deinked stock from the centrifugal pulper is taken through a consistency regulator where the stock consistency is adjusted and then is passed to the first of two Jonsson screens. The construction and use of the Jonsson screen has been the subject of a recent article (*2*). In this work the Jonsson screens employed were pilot models having a capacity about one-third of the commercial units. At the first screen a considerable portion of the larger nondefibered and deinked stock is rejected and is returned to the pulper. The accepted stock is sent to a second Jonsson screen where a further separation of the larger or coarser fibers is affected with the rejects from this screen also being returned to the pulper and the accepted stock being sent directly to the brown stock washers without further treatment.

The joint use of selective screening and disintegration with a high-speed refiner is illustrated by the flow-sheet in Fig. 3. It will be seen that the stock from the pulper is subjected to the action of a single Jonsson screen with the rejected stock being returned to the centrifugal pulper. The accepted stock from the Jonsson screen is then passed through a high-speed refiner which serves to break up the coarser fiber fractions which were not previously removed by the screen. After the treatment in the high-speed refiner, the stock is run directly to the brown stock washers without additional processing.

Effect of Pulping Waste Paper in an Impeller-Type Centrifugal Pulper

The effect of an impeller-type centrifugal pulper on the continuous pulping of waste paper has been discussed (*1*) but is again shown to illustrate the composition of the stock after the centrifugal pulper. Table I gives the results of a typical classification run. (It should be noted that different types of waste paper will change the classifications of the individual fractions somewhat.) Approximately 27% of the stock coming from the centrifugal pulper is retained on the 4, 10, 14, and 20-mesh screens and is referred to as the coarse fraction; about 34% is retained on 35, 42, 65, and 100-mesh screens as medium fraction; and about 39% is retained on or passes through the 170-mesh screen as the fine fraction.

Selective Screening with a Single Jonsson Screen

Data are presented in Tables II and III to show typical results obtained with a single Jonsson screen on stock from the centrifugal pulper and give a comparison of three screen plates having different size perforations: namely, a screen plate with $^{3}/_{16}$-inch holes spaced $^{5}/_{16}$ inch apart; a screen plate with $^{3}/_{16}$-inch holes spaced $^{9}/_{16}$ inch apart; and a screen plate with $^{1}/_{10}$-inch holes spaced $^{3}/_{32}$ inch apart. Other screen plates with larger openings have been tried but have given little separation. Also screen plates with smaller perforations have been tested but have been found to reduce screening capacity to a marked degree.

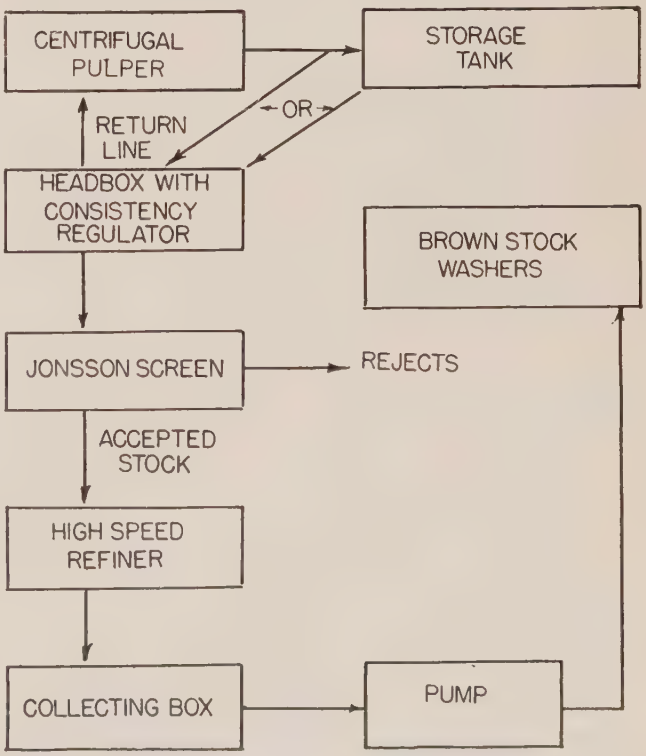


Fig. 3. Flow sheet of experimental system using single Jonsson screen and refiner

Table I. Effect of Pulping Waste Paper in an Impeller Type Centrifugal Pulper

Mesh retained on	*Waste paper before pulping, %*[a]	*White water, %*[a]	*Stock after pulping, %*[b]
4	98.1	...	3.9
10	...	...	13.0
14	...	...	2.5
20	...	...	7.4
35	...	...	14.9
42	...	...	3.5
65	...	...	4.3
100	...	0.1	11.1
170	...	0.1	3.4
Through 170	...	1.7	36.0
Coarse portion	98.1	...	26.8
Medium portion	...	0.1	33.8
Fine portion	...	1.8	39.4
	98.1	1.9	100.0

[a] In per cent of total suspended solids furnished.
[b] In per cent of suspended solids discharged from pulper.

It can be seen that the screen plate with $^1/_{10}$-inch holes has removed 98% of the 4-mesh, 57% of the 10-mesh, and smaller amounts of 14 to 20-mesh fractions. Taking these four classification fractions together as the coarse fractions, approximately 55% are taken out by this screen plate.

Table III. Classifier Fraction Size Removed by Single Jonsson Screen

Classifier screen size, mesh	*Using $^3/_{16}$-in. holes, $^5/_{16}$-in. centers, %*	*Using $^3/_{16}$-in. holes, $^9/_{16}$-in. centers, %*	*Using $^1/_{10}$-in. holes, $^3/_{32}$-in. centers, %*
4	83.9	93.8	97.5
10	5.7	26.1	57.1
14	10.5	46.1	38.3
20	43.2	8.8	21.3
Per cent removal of coarse fractions	27.9	40.5	54.8

The screen plate having $^3/_{16}$-inch holes spaced $^5/_{16}$-inch apart does not appear to yield results which are equal to those obtained with the other two screen plates. About 28% of the coarse fraction was removed with this screen plate.

Selective Screening with Two Jonsson Screens in Series

The data which are included in Tables IV and V illustrate typical results which are obtained when the accepted stocks from the first Jonsson screens (see previous Tables II and III) are subjected to the action of a second Jonsson screen and further coarse fractions are removed.

It will be noted that the screen plate having $^1/_{16}$-inch holes spaced $^7/_{64}$ inch apart gave about 18% or the least separation of the coarse fraction. However, the majority of the coarse fraction had already been removed by the first Jonsson screen having a screen plate with $^1/_{10}$-inch holes spaced $^3/_{32}$-inch apart.

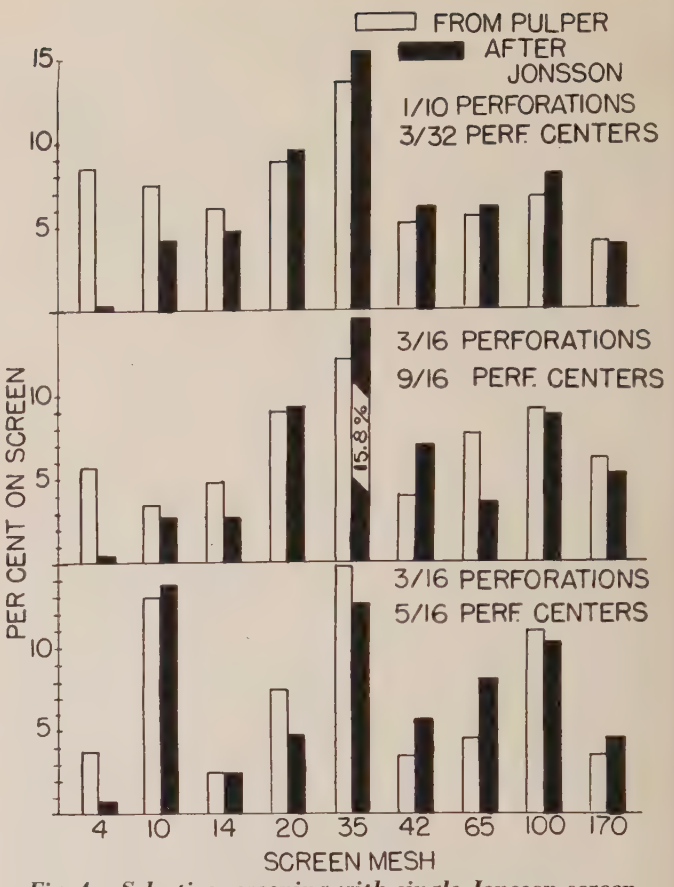


Fig. 4. Selective screening with single Jonsson screen

In the other two examples, the same Jonsson screen plate, $^1/_{10}$-inch holes spaced $^3/_{32}$-inch apart, has been used as the second screen. However, on stock coming from the first Jonsson screen plate having $^3/_{16}$-inch holes spaced $^5/_{16}$ inch apart, this screen gave better separation—30% removal of coarse fractions—than it did on stock coming from the first Jonsson screen having $^3/_{16}$-inch holes spaced $^9/_{16}$ inch apart where about 23% coarse fraction was removed.

Table VI is a tabulation of various operating characteristics of the three different Jonsson screen plate combinations described above. Approximately 63% of the coarse portions is removed by the $^1/_{10}$-inch hole

Table II. Selective Screening with Single Jonsson Screen

Screen plate perforations, in.		$^3/_{16}$		$^3/_{16}$		$^1/_1$	
Distance between perforation centers, in.		$^5/_{16}$		$^9/_{16}$		$^3/_{32}$	
Total fiber rejected by screen, %		10.5		10.8		25.5	
Total fiber accepted by screen, %		89.5		89.2		74.5	
Fiber classification of stock, mesh	*Stock from pulper, %*	*Accepted stock from Jonsson screen, %*	*Stock from pulper, %*	*Accepted stock from Jonsson screen, %*	*Stock from pulper, %*	*Accepted stock from Jonsson screen, %*
4	3.9	0.7	5.8	0.4	8.8	0.3
10	13.0	13.7	3.5	2.9	7.3	4.2
14	2.5	2.5	4.8	2.9	5.8	4.8
20	7.4	4.7	9.0	9.2	8.9	9.4
35	14.9	12.6	11.8	15.8	13.5	15.3
42	3.5	4.6	4.0	6.7	5.1	5.8
65	4.3	8.0	7.5	3.4	5.2	6.0
100	11.1	10.2	9.1	8.9	6.7	8.0
170	3.4	4.5	6.1	5.2	3.8	3.6
Past 170	36.0	38.5	38.4	44.6	34.9	42.6
Total	100.0	100.0	100.0	100.0	100.0	100.0
Per cent of coarse fractions	26.8	21.6	23.1	15.4	30.8	18.7

Table IV. Typical Selective Screening with Second Jonsson Screen on Accepted Stock from First Jonsson Screen

First Jonsson screen size, in.		3/16 holes, 5/16 centers		3/16 holes, 9/16 centers		1/10 holes, 3/32 centers	
Second Jonsson screen size, in.		1/10 holes, 3/32 centers		1/10 holes, 3/32 centers		1/16 holes, 7/64 centers	
Total fiber rejected by second screen		11.4		9.8		6.8%	
Total fiber accepted by second screen		88.6		90.2		93.2%	
Fiber classification of stock, mesh	*Stock from 1st screen, %*	*Accepted stock from 2nd screen, %*	*Stock from 1st screen, %*	*Accepted stock from 2nd screen, %*	*Stock from 1st screen, %*	*Accepted stock from 2nd screen, %*
4	0.7	0.1	0.4	0.0	0.3	0.0
10	13.7	10.0	2.9	2.0	4.2	2.2
14	2.5	2.0	2.9	2.1	4.8	4.2
20	4.7	5.1	9.2	9.1	9.4	10.1
35	12.6	17.3	15.8	13.8	15.3	15.5
42	4.6	5.1	6.7	6.4	5.8	6.6
65	8.0	8.0	3.4	4.9	6.0	6.3
100	10.2	12.3	8.9	9.7	8.0	11.6
170	4.5	4.4	5.2	5.9	3.6	3.5
Past 170 mesh	38.5	35.7	44.6	46.1	42.6	40.0
Total	100.0	100.0	100.0	100.0	100.0	100.0
Per cent of coarse fractions	21.6	17.2	15.4	13.2	18.7	16.5

first screen plate and 1/16-inch hole second screen plate combination and the accepted stock is comparable to that coming from the normal cooking process as will be shown later.

The combination of screen plates having 3/16-inch holes spaced 5/16 inch apart and 1/10-inch holes spaced 3/32 inch apart removed about 49% of the coarse fraction and the combination of screen plates having 3/16-inch holes spaced 9/16 inch apart and 1/10-inch holes spaced 3/32 inch apart removed about 30%.

Generally 2.0 to 3.0% consistency on the first screen gives best capacity and clearest screening and 1.0 to 2.0% consistency on the second screen was found to be satisfactory. A consistency which is too low not only reduced capacity of the screens but also lowers the quality of the stock. It has been observed that a higher percentage of coarse portions is passed at these lower consistencies than at the 2.0 to 3.0 consistency range.

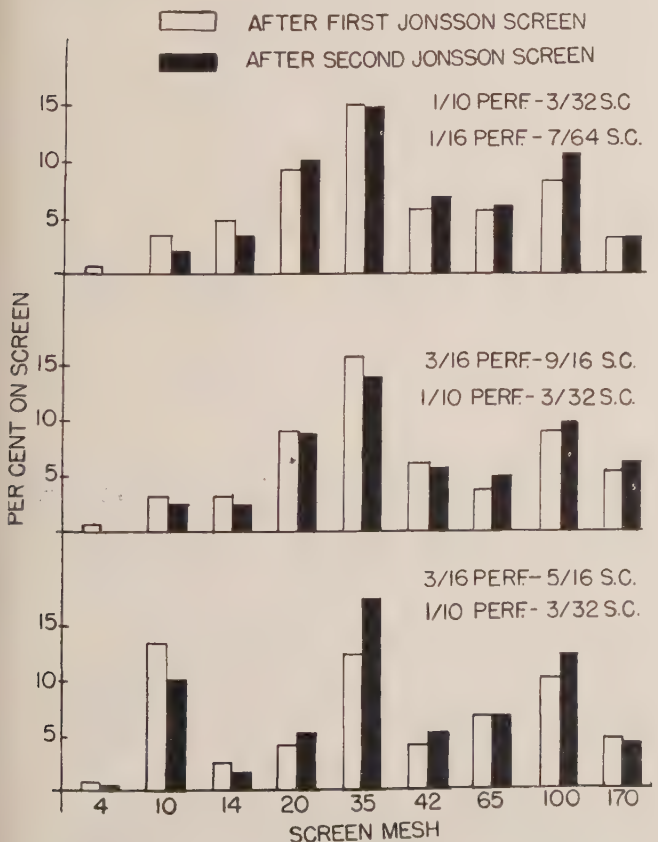


Fig. 5. Selective screening with second Jonsson screen on accepted stock from first

However, there is no set rule of consistency and if the stock from the centrifugal pulper is well broken up, a slightly higher consistency can be run. The percentage of rejects determines the optimum consistency since too high a consistency will carry over too much good fiber into the rejects. Also the finer the screen openings, the lower are the consistencies which can be used.

Table V. Typical Classifier Fraction Size Removed by Second Jonsson Screen from Accepted Stock from First Jonsson Screen

Classifier screen mesh	*1st Jonsson 3/16-in. holes 5/16-in. center; 2nd Jonsson 1/10-in. holes, 3/32-in. center, %*	*1st Jonsson 3/16-in. holes, 9/16-in. center; 2nd Jonsson 1/10-in. holes, 3/32-in. center, %*	*1st Jonsson 1/10-in. holes, 3/32-in. center; 2nd Jonsson 1/1 -in. holes, 7/64-in. center, %*
4	87.3	100	100
10	35.3	37.8	51.2
14	29.1	34.7	18.5
20	3.9	9.7	0.1
Removal of coarse fractions, %	29.4	22.7	17.8

The capacity of the screens depends on the quality of the stock. If the percentage of coarse fractions in the stock runs too high, it is necessary to "ease up" on the loading of the screens or otherwise too much good fiber is returned in the rejected stock.

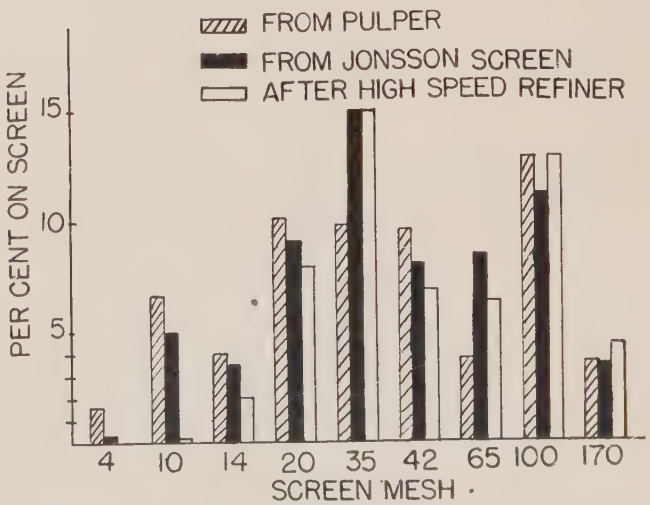


Fig. 6. Typical screening and refining with use of Jonsson screen and high-speed refiner (Jonsson screen 3/16 perf. 9/16 S. C.)

Screening and Refining with Use of One Jonsson Screen and a High-Speed Refiner

Experiments with the two Jonsson screens have indicated that a screen plate could be chosen for the first screen to take out the larger part of the 4 and 10-mesh fractions, also the scrap metal and trash such as staples, pins, cellophane, strings, and wet-strength broke. Hence, it has been considered possible to draw stock from the first Jonsson screen and pass it through a high-speed refiner to reduce the coarse fraction and make suitable stock without the necessity of further screening. In operation the refiner is run to give only a light brushing and on Canadian Standard freeness tests there is a drop of only 10 to 15 points on the refined stock.

Table VI. Operating Characteristics of Various Jonsson Screen Combinations

1st Jonsson screen size	3/16-in. holes, 5/16-in. centers	3/16-in. holes, 9/16-in. centers	1/10-in. holes, 3/32-in. centers
2nd Jonsson screen size	1/10-in. holes, 3/32-in. centers	1/10-in. holes, 3/32-in. centers	1/16-in. holes, 7/64-in. centers
Removal of all coarse fractions, %	48.5	30.3	62.7
Consistencies (moisture-free)			
into 1st Jonsson, %	1.46	2.35	1.82
through 1st Jonsson, %	1.38	2.06	1.73
into 2nd Jonsson, %	1.27	1.70	1.47
through 2nd Jonsson, %	0.98	1.46	1.37
Rejects 1st Jonsson, %	10.5	10.8	25.5
Rejects 2nd Jonsson, %	10.2	10.3	5.1
Total rejected, %	20.7	21.1	30.6
Capacity, moisture-free tons/24 hr.	3.2	6.5	3.1

Tables VII and VIII show that the stock which has passed through the refiner has had all 4-mesh and almost all 10-mesh fractions removed. Also large percentages of the 14 and 20-mesh portions have been eliminated; it was noted that the 14 and 20-mesh fractions, which still remain, consist largely of long individual fibers and are acceptable for use.

Whereas two Jonsson screens in combination remove about 63% of the coarse fractions, the use of one Jonsson screen and the refiner takes out about 60% of the coarse material. Therefore, the use of the refiner-screen combination compares favorably with

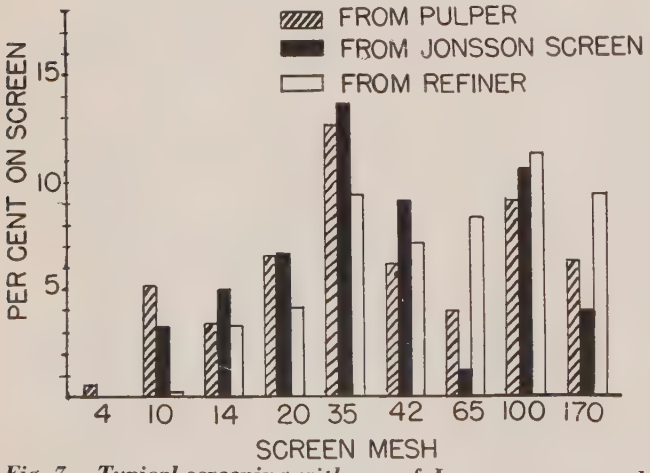


Fig. 7. Typical screening with use of Jonsson screen and high-speed refiner

Stock allowed 2-hour soak before screening and refining.

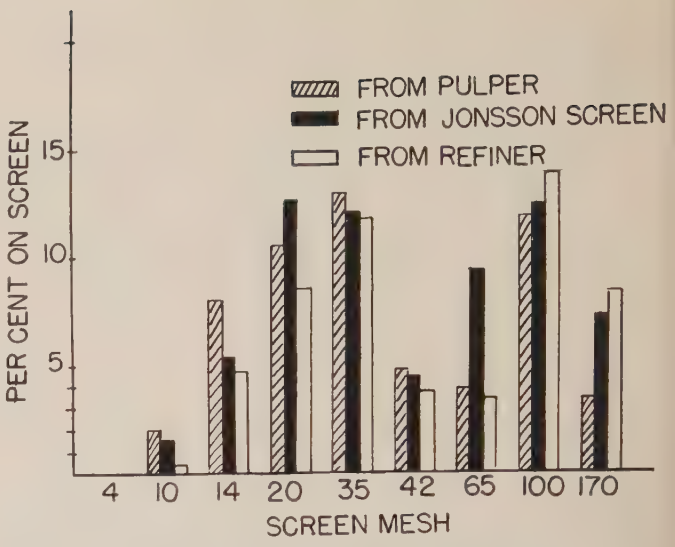


Fig. 8. Typical screening with use of Jonsson screen and high-speed refiner

Stock allowed 13-hour soak before screening and refining.

that of the two Johnsson screens (and will be further shown, with that produced by the normal mill cooking procedure).

Effect of Soaking Period on the Stock before Screening and Refining

In the experimental runs which have been described above it was observed that the partially deinked stock from the centrifugal pulper could be defibered by screening and refining to compare favorably with the stock produced in the mill cooking practice. However, in some cases the ink is not softened and when it is broken up by the refining, it gives rise to very small fine "pepper spots." Some of these are removed by the washing stage but a number are carried through the bleaching and appear in the final bleached product.

Table VII. Screening and Refining with Single Jonsson Screen and High-Speed Refiner

Classifier screen mesh	*Stock from pulper, %*	*Accepted stock from Jonsson screen, %*	*Stock after refiner, %*
4	1.6	0.3	0.0
10	6.7	5.0	0.1
14	4.0	3.5	2.0
20	10.2	9.1	7.9
35	9.8	15.0	15.0
42	9.6	8.0	6.9
65	3.8	8.4	6.3
100	12.9	11.2	12.9
170	3.6	3.5	4.4
Past 170	37.8	36.0	44.5
Total, %	100.0	100.0	100.0
Per cent of coarse fraction	22.5	17.9	10.0

Table VIII. Classifier Fraction Size Removed by Jonsson Screen and High-Speed Refiner

Classifier screen mesh	*Removal by Jonsson screen alone, %*	*Removal by Jonsson screen and high-speed refiner, %*
4	84.9	100.0
10	33.9	81.3
14	20.9	54.9
20	20.9	30.8
Per cent removal of coarse fractions	29.4	60.0

Table XI. Comparison of Stock from Selective Screening and Refining against Stock from Mill Process

Fiber classification screen mesh	Stock from experimental run: From centrifugal pulper, %	Accepted stock from Jonsson screen, %	Stock after refiner, %	Stock at washers, %	Stock from mill run: Before cooking, %	From cooking process, %	Stock at washers, %
4	0.2	0.0	0.0	0.0	1.0	0.0	0.0
10	1.3	2.8	0.1	0.4	7.9	0.3	0.5
14	7.8	3.7	0.8	1.2	5.0	3.5	6.5
20	10.8	8.9	7.3	18.2	8.7	9.1	16.1
35	14.6	14.4	14.6	16.6	16.3	18.3	23.6
42	6.0	4.6	16.4	15.0	4.7	6.7	6.4
65	3.6	3.7	2.1	5.9	7.0	8.3	12.3
100	9.1	10.0	2.3	11.6	10.6	11.8	12.3
170	7.7	9.9	3.8	7.3	7.6	8.9	7.8
Past 170	38.9	42.0	52.6	23.8	31.2	33.1	14.5

In the previously described experimental runs the partially deinked stock was drawn off directly from the centrifugal pulper. Hence, trials were made to determine whether or not a "soak period" would be beneficial by allowing the alkali time to act on the ink and soften it.

Table IX. Screening and Refining with Single Jonsson Screen and High-Speed Refiner. (Stock allowed 2-hr. soak before screening and refining)

Classifier screen mesh	Stock from pulper, %	Accepted stock from Jonsson screen, %	Stock after refiner, %
4	0.6	0.0	0.0
10	5.2	3.3	0.2
14	3.4	5.0	3.3
20	6.6	6.7	4.2
35	12.7	13.7	9.4
42	6.2	9.2	7.4
65	4.0	1.3	8.4
100	9.2	10.7	11.4
170	6.4	4.1	9.5
Past 170	45.7	46.0	46.2
Total	100.0	100.0	100.0
Per cent of coarse fractions	15.8	15.0	7.7

It was found in these later tests that this "soak period" is advantageous. The percentages of 4 and 10-mesh fractions are reduced, and the ink appears to come off and wash out more easily on the washers. Tables IX and X illustrate typical classification tests made on stock identical to that reported in Table XIII but given 2 and 13-hour soaking periods, respectively. It appears that a 2-hour soak is satisfactory.

Comparison of Experimental and Mill Cooking Process Stocks

The stock produced by the use of selective screenings and disintegrating with a high-speed refiner has been compared to stock obtained in normal mill deinking operations. Visual inspection show that the stock from the experimental runs is comparable in cleanliness and color to that from the usual cooking procedure. Physical strength tests, chlorine number tests, and bleachability tests are likewise very similar. Table XI gives typical data on experimental and mill-cooked stocks.

Table X. Screening and Refining with Single Jonsson Screen and High-Speed Refiner. (Stock allowed 13-hr. soak before screening and refining)

Classifier screen mesh	Stock from pulper, %	Accepted stock from Jonsson screen, %	Stock from refiner, %
4	0.0	0.0	0.0
10	2.0	1.5	0.3
14	8.0	5.3	4.7
20	10.5	12.6	8.5
35	12.9	12.0	11.7
42	4.7	4.4	3.7
65	3.9	9.3	3.4
100	11.8	12.3	13.7
170	3.4	6.2	7.3
Past 170	42.8	36.4	46.7
Total	100.0	100.0	100.0
Per cent of coarse fractions	20.5	19.4	13.5

Stock after the refiner and stock from the normal cooking process, do not have any 4-mesh and very little 10-mesh fractions present. Stock from the refiner runs slightly lower in 14 and 20-mesh fractions.

Savings in Steam and Power with Experimental Process

In mill practice the partially defibered and deinked stock from centrifugal pulper is taken at a temperature of about 120°F. and is cooked at 170°F. to complete the defibering and deinking action. The steam required for this heating would, therefore, be saved by the experimental process and this would amount to about 40% of that used in the present mill deinking process.

A considerable amount of power is used in the cooking process for pumping and circulating systems. It is estimated that with the Jonsson screens and high-speed refiner combination, about 80% of the power could be saved.

SUMMARY

1. It has been found possible by selective screening with two Jonsson screens to produce a stock which is defibered and deinked comparable to that produced in normal cooking practice, as far as can be determined experimentally.

2. By screening with a single Jonsson screen and by disintegrating with a high-speed refiner a stock comparable to that from normal cooking operations can also be obtained.

3. Savings of about 40% in steam per ton of brown stock can be realized by use of the experimental process.

4. Savings of about 80% in power also would be possible from the experimental system.

LITERATURE CITED

1. Bailey, H. P., Nadelman, A. H., and Andrews, E. F., *Tech. Assoc. Papers* 31: 265–269 (1948).
2. Bird Machine Company, *Pulp Paper Mag. Canada* 46, no. 4: 362, 364 (March, 1945).

RECEIVED Feb. 4, 1949. Presented at the Annual Meeting of the Technical Association of the Pulp & Paper Industry, New York, N. Y., Feb. 21–24, 1949.

The authors wish to acknowledge the assistance of the staff of the Niagara mill and to express their appreciation to the Division of Research of the International Paper Co. for use of laboratory equipment required in experiments. The Jonsson screens used in this work have been furnished by the Bird Machine Co., and their cooperation and valuable assistance has been most helpful.

Utilization of Methoxy Lignin Chloride by Resinification

RAPHAEL KATZEN, IRVING KRUSHEL and DONALD F. OTHMER

Resin-forming characteristics were noted for methoxy lignin chloride obtained by chlorinating wood in boiling methanol. Esterification reactions yielded light-colored transparent thermoplastic resins. A series of resins, obtained with different proportions of MLC and phthalic anhydride, varied in melting point and melting range indicating the possibility of controlling the degree of thermoplasticity of the resinous products. Self-polymerization of MLC was noted, and application of catalysts, particularly benzoyl peroxide, yielded heat-stable resins, light in color and thermoplastic. All ester resins and poly-condensation resins were formed by reaction in boiling methanol under a chlorine atmosphere.

Methoxy lignin chloride obtained by the new process described in an earlier paper (*1*) showed interesting chemical and physical properties. MLC obtained from 12 species of wood contained from 16.2 to 24.6% methoxyl and from 23.4 to 32.9% chlorine. Eliminating three resinous species (yellow pine, sugar pine, and redwood), analyses varied only from 19.6 to 22.0% for methoxyl and from 25.9 to 29.7% for chlorine. MLC from every species was a water insoluble, amorphous and nonhygroscopic powder, ranging from cream to orange-yellow in color, tending to decompose at or before the melting point (about 100 °C.) which is not sharp and varies with moisture content.

Solubility of redwood MLC was determined in cold and boiling solvents (Table I). When methanol evaporates from a solution of MLC, a light yellow powder remains with only occasional indications of a film-forming fraction. Thus, MLC is essentially nonresinous.

Since lignin esters can be synthesized, it appeared that the highly chlorinated MLC should give condensation reactions. Preliminary tests in a chlorine atmosphere gave the following results:

1. Redwood MLC boiled for 10 hours in glacial acetic acid yielded 7.25% of a solid yellow resin after precipitation in water.

2. Jack pine MLC boiled in methanol for 20 hours with 25% of its own weight of citric acid yielded 92% of the weight of the reactants as a hard, clear orange-red resin after evaporation of the solvent.

3. The same reaction as (2) utilizing lactic acid instead of citric yielded 12% of a light-yellow methanol insoluble resin plus 92% of a hard clear orange-red resin after evaporation of the solvent. The yield of over 100% may have been caused by additional methoxylation and chlorination.

4. Maple MLC reacted with an equal weight of phthalic anhydride in boiling methanol for 5 hours to yield a two-phase liquid after evaporation of part of the solvent on a stream bath. Additional heating for 2 hours at 100 °C. under vacuum evaporated the balance of the solvent and left a transparent oily resin which slowly hardened upon further heating at 100 °C.

Any interruption of chlorine flow maintaining this supernatant atmosphere during runs similar to those above yielded dark precipitates, evidencing decomposition. Quick resumption of chlorine flow lightened color of the reacting solution again.

Quantitative studies were made with redwood MLC—phthalic anhydride condensations following the last experiment, as shown in Table II. Reaction was carried out at the boiling point of methanol for an arbitrary time of 10 hours. Methanol insoluble resin was separated by decantation, while methanol soluble resin was recovered by precipitation in water.

Although there was no consistent relationship between methanol soluble and insoluble resin yields, and reactant proportions, it is significant that the total resin yields average approximately 114% of the reactant weights. The abnormal yields can be accounted for only by assuming a further addition of methoxyl and chlorine. A plot (Fig. 1) of the analyses of the methanol insoluble resins shows that chlorine content does not decrease in proportion to reduced amount of MLC in the reaction; and methoxyl content actually increases. The latter analysis may be affected by the

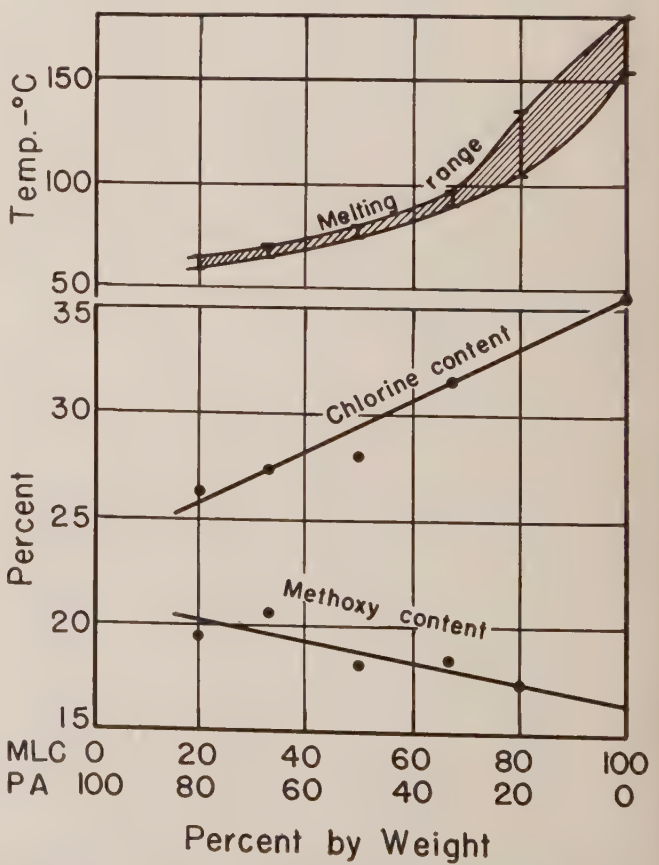


Figure 1. Properties of methoxy lignin chloride—phthalic anhydride resins

Raphael Katzen, Irving Krushel, and Donald F. Othmer, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Table II. Methoxy Lignin Chloride—Phthalic Anhydride Resins

Run[a]	Reactants, g. MLC	Reactants, g. P. A.	Yield of resins per cent MLC, P. A. MeOH insoluble	Yield of resins per cent MLC, P. A. MeOH soluble	Yield of resins per cent MLC, P. A. Total	Analysis (MeOH insoluble resin) OCH_3, %	Analysis (MeOH insoluble resin) Cl, %	Melting range, °C.
122[b]	0	20	..	...	...	...	...	...
118	5	20	15	100	115	19.7	26.4	60–65
116	10	20	23	74	97	20.8	27.4	65–70
114	20	20	16	97	113	18.3	28.1	75–80
115	20	10	40	73	113	18.6	31.8	90–95
120	20	5	68	66	134	17.4	34.2	105–135
121	20	0	23	88	111	16.6	35.5	155–180

[a] All runs used 200 ml. MeOH.
[b] No resin yield.

Table I. Solubility of Redwood Methoxy Lignin Chloride

Solvent	Boiling point, °C.	Solvent solubility in water[a]	Solubility of methoxy lignin chloride[b] at 25°C.	Solubility of methoxy lignin chloride[b] at boiling point of solvent
Methanol	64.5	Infinite	Soluble	Soluble
Ethanol, 95%	78.2	Infinite	Slightly soluble	Soluble
n-Propanol	97.2	Infinite	Slightly soluble	Soluble
iso-Propanol	82.4	Infinite	Insoluble	Soluble
n-Butanol	117.7	7.9	Slightly soluble	Soluble
sec-Butanol	99.5	12.5	Insoluble	Soluble
tert-Butanol	82.9	V. Soluble	Insoluble	Soluble
Benzene	80.1	0.073	Insoluble	Slightly soluble
Carbon tetrachloride	76.8	0.080	Insoluble	Insoluble
Chloroform	61.2	0.621	Soluble	Soluble
Acetone	56.1	Infinite	Slightly soluble	Soluble
Ethyl ether	34.5	7.42	Slightly soluble	Slightly soluble
Acetic acid	118.2	Infinite	Soluble	Soluble
Dioxane	101.4	Infinite	Soluble	Soluble
Methyl cyclohexane	101.2	Insoluble	Insoluble	Insoluble

[a] Grams per 100 ml. of water.
[b] 0.15 grams per 5 ml. of solvent.

phthalate group present, but it would be expected that the effect would be more pronounced with greater amount of phthalic anhydride. The melting range curve indicates that with increased ratio of phthalic anhydride to MLC, and potentially increasing degree of esterification, the resin becomes more homogeneous and thermoplastic. The reduction of the melting range with increasing phthalic anhydride content may be due to inhibition of polymerization of the MLC molecules. The larger melting range of MLC when subjected to the reaction conditions in the absence of phthalic anhydride shows that some polymerization has taken place.

The methanol insoluble fraction obtained from MLC as noted above after refluxing in methanol under a chlorine atmosphere for 10 hours was probably a poly-condensation product. The low yield and slow rate of reaction indicated the need for a catalyst. Trials with aluminum chloride yielded an extremely violent reaction, and the completely methanol insoluble resin obtained (100% yield as shown in Table III) was so dark that decomposition had obviously occurred. After drying at 50°C., this resin was stable up to 200°C. at which temperature it was viscous and thermoplastic.

Reactions with benzoyl peroxide catalyst were more controllable. Data in Table III show that MLC is gradually converted to a methanol insoluble resin at 48 hours, and partial decomposition may then occur reducing yields with additional reaction time. Methoxyl content decreases and chlorine content increases during the poly-condensation reaction.

Redwood MLC resins obtained with benzoyl peroxide catalysis were yellow and transparent, melting from 150 to 200°C. without decomposition or darkening, and were essentially thermoplastic. Jack pine MLC resin melted at 100°C. with some darkening. All of the resins were soluble in benzene, and from this solution formed tenacious, transparent, light-yellow films on glass and tin-plate. These films showed excellent resistance to moisture on water immersion.

CONCLUSIONS

MLC is more highly methoxylated, lighter colored, and more stable than previously known lignin materials. MLC is recovered in solid form simultaneously with recovery of methanol in the reaction and wash liquors. The utility of this new product will determine the commercial practicability of the process.

MLC-phthalate ester resins have been prepared, both thermoplastic and thermosetting. These lignin resins are light colored and transparent, but are somewhat heat sensitive. More stable resins have been prepared by poly-condensation of MLC in the presence of benzoyl peroxide catalyst. These latter resins are thermoplastic, may be cast, or formed into films on glass or metal from benzene solution. The films are brittle indicating the need for compounding with plasticizers. Qualitative tests of these MLC cast resins and films have shown that they have high water and acid resistance.

LITERATURE CITED

1. Katzen, Raphael, Pearlstein, Joseph, Muller, Robert E., and Othmer, Donald F., *Tappi* 33, No. 2: 67–72 (Feb., 1950).

Received Nov. 7, 1949. Appreciation is expressed to the Northwood Chemical Co. of Phelps, Wisconsin for financing this work and to A. O. Reynolds, General Manager for his help and personal interest.

Table III. Catalysis of Methoxy Lignin Chloride Resinification

Run	MeOH, ml.	MLC, g.	Catalyst	Grams	Reflux, hr.	Resin yield, % MeOH insoluble	Resin yield, % MeOH soluble	MeOH insoluble resin OCH_3, %	MeOH insoluble resin Cl, %
132	100	10	A.C.[a]	2.0	24	100	0	15.1	41.1
131	100	10	B.P.[b]	0.1	24	65	45	...	...
139	500	100	B.P.	1.0	48	97	0	13.0	43.0
133	250	25	B.P.	0.25	72	88	0	9.6	41.1

[a] Aluminum chloride.
[b] Benzoyl peroxide.

Utilization of Cellulose from Methanol-Chlorination of Wood

RAPHAEL KATZEN, ROBERT S. ARIES, KJELL GORANSON, and DONALD F. OTHMER

Crude cellulose obtained from methanol-chlorination of wood was purified by treatment with sodium hydroxide and sodium hypochlorite. A study of effects of concentration of reactants and time of reaction yielded optimum conditions for obtaining a good grade of chemical, or dissolving, pulp. It was noted, however, that acidic conditions of the pulping process prior to purification, affected the final pulp quality. With proper control of the pulping and purification processes, a pulp was obtained from jack pine by single-stage purification containing 92.2 alpha-cellulose, and having a TAPPI viscosity of 23.6 cp. More moderate purification treatments yielded readily hydratable pulps showing drainage characteristics suitable for papermaking. In this case it was also found that acidic conditions of the pulping process could destroy hydrating characteristics unless properly controlled. Shorter pulping periods resulted in less removal of hemicelluloses improving beating characteristics.

THE CELLULOSE product obtained from methanol-chlorination of wood (*1*) required purification for utilization as pulp. Alkali and bleach treatments were carried out to determine effects on yields, alpha-cellulose content, and viscosity; for evaluation of the product as a chemical, or dissolving, pulp.

Pulp purifying variables studied were (1) sodium hydroxide concentration, (2) time of caustic treatment, (3) sodium hypochlorite concentration, and (4) time of bleach treatment.

Alpha-cellulose was determined by the standard ACS method (*2*). Corrections were not made for residual lignin; and in the case of causticized celluloses, retention of lignin was appreciable. In most of the bleached celluloses, residual lignin content was negligible as noted by checks of chlorine and methoxyl contents of the purified products. The residual lignin as determined by the ACS method, however, was far in excess of the possible retention, indicating that small amounts of residual MLC have a strong protective influence on cellulose inhibiting acid hydrolysis. (This same effect was noted in the methanol-chlorination process itself.) Viscosities were measured by the TAPPI standard method (*3*) at 1% cellulose concentration, and with the Ostwald viscosimeter at 0.1% cellulose concentration. Polymerization degrees were calculated by Staudinger's equation.

Effects of sodium hydroxide concentration on purified cellulose are shown in Table I. (C-A designated crude cellulose, C-B is causticized cellulose, and C-A is the bleached product.) Sodium hydroxide used was based on the weight of dry crude cellulose and was dissolved in water amounting to 10 times the weight of dry crude cellulose. The pulp was boiled in the caustic solution at atmospheric pressure for 1 hour, filtered, and washed thoroughly. Uniform bleaches were used consisting of 11% NaOCl (5% solution), based on the weight of dry causticized pulp, distributed in water equal to 10 times the weight of the pulp with treatment at room temperature (20 to 24°C.) for 1 hour, followed by filtration and washing.

Table I. Cellulose Purification—Caustic Variable

Run	NaOH per cent C—A	Yield C—B, per cent C—A	Per cent alpha-cellulose in C—B	Yield C—C, per cent C—A	Per cent alpha-cellulose in C—C	TAPPI viscosity cp.	TAPPI viscosity specific	P.D.
57A	5.3	89.0	50.6	58.2	55.5	3.84	1.06	99
57B	11.0	63.0	63.0	47.0	65.5	4.17	1.40	130
57C	22.0	66.5	77.0	54.9	81.5	4.26	1.29	125
57D	33.0	62.8	83.2	60.1	88.5	4.32	1.46	136
57E	44.5	61.0	72.0	47.9	70.0	4.30	1.50	134

Selecting a caustic concentration near the optimum from the first set of runs at 27% of the weight of the crude cellulose, caustic treating times were varied as indicated in Table II. Bleaching was uniform as above. Pulp used in the foregoing experiments showed excessive degradation due to hydrolysis during the methanol-chlorination process. Pulp samples for the following runs were removed from the methanol-chlorination reaction immediately after delignification and washed free of acid at once.

With caustic treatment based on 27% of the crude cellulose, boiling for 90 minutes, a batch of pulp was prepared for bleaching experiments. Bleaching time was held constant at 1 hour in the runs listed in Table III and 5% NaOCl solution was utilized to bleach the cellulose in the proportions shown.

Ten per cent NaOCl (5% solution) based on the causticized pulp was taken as the desirable bleach concentration, and time of bleaching was varied. Data in Table IV show that although the bleach agent was substantially exhausted after 100 minutes, secondary reactions continued degradation of the cellulose.

This series of bleach-time experiments yielded a high-viscosity pulp with a low alpha-cellulose content at 100 minutes. The data indicated that a somewhat stronger alkali treatment and milder bleach might yield improved results. Another sample of jack pine crude pulp from the methanol-chlorination process was treated as follows:

30% NaOH (3% concentration in water)
90 minutes caustic boiling time
5% NaOC (5% solution) (0.25% concentration in water)
30 minutes bleaching time.

The clean white pulp obtained had the following properties: alpha-cellulose content, 92.2%; TAPPI viscosity, 23.6 cp.; and polymerization degree, 1070. Alpha-cellulose in the purified pulp was equivalent to

RAPHAEL KATZEN, ROBERT S. ARIES, KJELL GORANSON, and DONALD F. OTHMER, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Table II. Cellulose Purification—Caustic Time Variable

Run	Time of boiling, min.	Yield C—B, per cent C—A	Per cent alpha-cellulose C—B	Yield C—C, per cent C—A	Per cent alpha-cellulose in C—C	TAPPI viscosity cp.	TAPPI viscosity specific	TAPPI viscosity P. D.	Ostwald viscosity cp.	Ostwald viscosity specific	Ostwald viscosity P. D.
59A	20	84.0	56.0	79.0	62.0	4.09	1.25	116	1.52	0.122	115
59B	40	71.2	63.5	65.5	74.5	4.55	1.53	142	1.51	0.117	109
59C	60	58.0	77.5	54.0	84.8	4.82	1.58	148	1.54	0.137	127
59D	90	51.0	77.0	50.0	92.0	4.36	1.45	135	1.54	0.138	129
59E	150	41.2	74.8	37.6	88.8	3.88	1.11	104	1.54	0.137	127

37% of the dry jack pine treated in the methanol-chlorination process indicating only moderate overall degradation of this component in the pulping and purification process.

BEATING PULP

Beating and hydration characteristics of pulp were tested in a Nobel and Wood laboratory beater at a consistency of 2.5% pulp in water with the beater roll brushing the bed-plate at 450 r.p.m. Measurements of drainage rate of the beaten pulp were set up on an arbitrary basis. Sixty milliliter samples from the beater were mixed with 410 ml. of water in the test chamber (2-inch pipe) and drained through a 100-mesh screen in the bottom of the chamber until the liquid level fell from 9 to 3 inches, measuring the time interval equivalent to this fall.

Table III. Cellulose Purification—Bleach Variable

Run	NaOCl per cent C—B	Yield C—C, per cent C—A	Per cent alpha-cellulose in C—C	TAPPI viscosity cp.	TAPPI viscosity specific	TAPPI viscosity P. D.	Ostwald viscosity cp.	Ostwald viscosity specific	Ostwald viscosity P. D.
81A	5	85.3	74.5	17.5	0.451	815	3.25	0.451	420
81B	10	80.1	69.0	20.9	0.524	1080	3.41	0.524	490
81C	15	75.9	68.5	19.0	0.481	837	3.33	0.481	450
81D	20	70.0	67.0	15.5	0.476	690	3.30	0.476	443

Beating pulp samples were submitted to milder causticizing and bleaching treatments to permit retention of readily hydratable hemicellulose. Initial trial on pulp, which had been subjected to excessive acid degradation in the primary methanol-chlorination reaction, showed that the cellulose so produced would not hydrate, and was only reduced to a powder by the beater action. Subsequent runs were made on cellulose removed from the primary system immediately after delignification and before extensive acid degradation had occurred (about 2 hours in semipilot plant runs).

(a) Jack pine crude cellulose from a semipilot plant methanol-chlorination of $2^1/_2$ hours duration was purified by boiling for 1 hour with 15% NaOH (based on dry crude pulp) in 10:1 suspension; then bleached at room temperature for 1 hour with 11% NaOCl (5% solution), based on dry causticized pulp, in 10:1 suspension.

(b) Jack pine crude cellulose from a similar run of $1^1/_4$ hours duration was treated with 5% NaOH in 7.5:1 suspension, boiled for 1 hour, and bleached with 7% NaOCl (5% solution) in 10:1 suspension at room temperature for 1 hour. Percentages of treating agents are again based on the dry weight of the cellulose treated.

Drainage rates for both tests are given in Table V. It is evident that the pulp in test (a), subjected to the more protracted methanol-chlorination and more vigorous causticization and bleaching, did not hydrate as rapidly, or to as high a degree as the pulp in test (b). Evidently the former treatment resulted in excessive removal of hemicellulose.

CONCLUSIONS

The crude cellulose residue obtained from methanol-chlorination of wood is of no apparent value as recovered. Purification experiments prove that a single-stage treatment with boiling caustic and cold sodium hypochlorite bleach may be controlled to yield a chemical cellulose with an alpha-cellulose content of 92% and a viscosity in the range of commercially required values. This purified cellulose may be sheeted, is white in color, and is obtained in yields at least equivalent to those of similar quality pulps from standard pulping processes. The foregoing results were obtained on jack pine which is one of the species of wood most resistant to pulping by standard processes.

Table V. Beating Pulp Drainage Tests

Beating time, min.	Drainage time, sec. (a)	Drainage time, sec. (b)
2	...	3.5
5	7.8	13.0
10	11.9	34.2
15	...	68.3
20	21.5	68.1
30	24.5	...
60	27.9	...

Table IV. Cellulose Purification—Bleach Time Variable

Run	Time of bleach, min.	Yield C—C, per cent C—A	Per cent alpha-cellulose	TAPPI viscosity cp.	TAPPI viscosity specific	TAPPI viscosity P. D.	Ostwald viscosity cp.	Ostwald viscosity specific	Ostwald viscosity P. D.
81E	30	82.0	79.5	20.4	0.540	907	3.46	0.548	498
81F	60	80.1	69.0	20.9	0.524	1080	3.41	0.524	490
81G	100	74.2	66.8	24.0	0.629	1115	3.64	0.629	585
81H	195	72.5	66.0	18.5	0.50	805	3.34	0.500	466

Beating experiments showed that milder methanol-chlorination and purification treatments would have to be used for production of paper pulp. With proper control of these factors a hydratable jack-pine pulp was obtained which gave, however, a brittle paper sheet. This was probably due to the properties of this particular species of wood.

Although the evaluation of methanol-chlorination cellulose as beating, or paper, pulp was not carried out, it is indicated that the product may be readily converted to a chemical, or dissolving pulp in which use it would be of greater economic value.

LITERATURE CITED

1. Katzen, Raphael, Pearlstein, Joseph, Muller, Robert E., and Othmer, Donald F., *Tappi* 33, No. 2: 67–72 (Feb., 1950).
2. Ritter, G. J., *Ind. Eng. Chem.* 1: 52 (1929).
3. Technical Association of the Pulp and Paper Industry, New York, N. Y.

Received Nov. 7, 1949. The authors wish to express their appreciation for the aid and assistance given by the Northwood Chemical Co. of Phelps, Wis., sponsor of the fellowship which permitted the planning and execution of this work.

Eucalypt Pulps from Water Prehydrolysis and Sulphate Pulping

The Process and Resultant Pulp Properties

ALEXANDER MELLER

A mixture of species of eucalypt woods precooked with water at 85 pounds pressure followed by sulphate pulping at 45 pounds pressure, applying 19 to 30% alkali, resulted in pulps with practically the same xylan contents ranging from 3 to 2.8%. The percentage alkali applied in the sulphate pulping stage influenced significantly the pulp yield, bleachability, and solution viscosity of the derived pulps. *Eucalyptus regnans* wood samples precooked with water at 95 to 100 pounds steam pressure showed a low pentosan content (5%) when compared with that of the original woods (17 to 18%). The water precooked woods delignified readily by hot alkali solutions and the pentosan content was also reduced by alkali treatment. The "difficultly soluble xylan fraction" of the water precooked woods was much lower than that of the parent woods. Precooking the eucalypt wood samples with water at 95 to 100 pounds pressure, followed by sulphate pulping of the precooked chips at 46 to 60 pounds pressure, applying 18 to 20% alkali, resulted in pulps in 31–33% yield. Additional bleaching without alkaline purification yielded fibers containing 1.5 to 1.8% total and 1% resistant pentosan, and 93 to 96% alpha-cellulose content.

The interest in the production of purified wood pulps from hardwoods has been growing, and the preference given to softwoods for the production of paper pulp and dissolving grades of cellulose seems to have decreased considerably in significance. This is partly attributable to a gradually diminishing supply of coniferous pulp woods in some countries and partly to the advances made in the technical processing of hardwoods for papermaking, as well as in the successful conversion of hardwood fibers into cellulose derivatives. Furthermore, fiber length is less important in the utilization of cellulose for dissolving purposes than in paper pulps.

Hardwood pulps produced by the sulphite process, after bleaching and purification by hot alkaline solutions, have been used in the production of viscose rayon (*1*). Such pulps, when further purified by cold alkaline refining, have apparently been only moderately adaptable to conversion into high-quality cellulose acetates and ethers (*2*).

Hardwood sulphate pulps, produced under the usual pulping conditions, contain a relatively high percentage of pentosans (*1*) even after bleaching and purification by strong alkali solutions (*3*, *4*, *5*, *6*, *7*). The amount of pentosans insoluble in strong cold alkali solutions ("resistant pentosans") may be indicative of difficulties encountered in several steps of various cellulose conversion processes (*2*). A reduction of the "resistant pentosans" can be obtained by acid treatment, or more efficiently, by alkaline hypochlorite bleaching, applied to partially bleached pulps (*8*). Experiments on sugar maple sulphate pulp (*1*), indicated that when purified by acid hydrolysis of the unbleached fibers with subsequent cold alkaline refining and bleaching, it was a suitable raw material for the production of viscose rayon.

The hydrolysis of pentosans by acid treatment of partially bleached sulphate pulps is apparently less selective (*8*), but it may be more selective when applied to unbleached sulphate pulp. However, it seems that when hardwoods are subjected to acid treatment before an alkaline pulping, the action of the acid is particularly selective in the removal of the pentosans, since the pentosan content of the fibers after alkaline pulping is relatively low and the pulp yield is relatively high (*2*, *6*, *7*, *9*, *10*, *12*, *13*, *14*, *15*).

The essentially common feature of these processes is that wood chips are first subjected to a treatment with mineral acid solutions at high temperatures, and the acid treated wood is pulped in a subsequent step by alkaline solutions. Such pulps show a high degree of purity (low pentosan and high alpha-cellulose contents) after bleaching which can be increased by cold alkaline refining.

On heating wood chips with water, organic acids are liberated which presumably exert an effect similar to that of mineral acids. The relevant literature, however, is somewhat confusing as regards the success of the application of water in the "prehydrolysis" step. Dörr (*16*) contended that the hydrolytic breakdown of the hemicelluloses by the acid liberated when beechwood was heated with water, was insufficient. The suggestion (*17*) of adjusting the pH of the acid solution obtained by heating wood with water to be used for prehydrolysis, would be in harmony with this view.

Alexander Meller, Senior Research Chemist, Australian Paper Manufacturers Ltd., Melbourne, Australia.

By applying water to aspen wood for comparatively long periods and at 170 and 186°C., 90 to 95% of the pentosans were removed. The total quantity of lignin remained practically constant but a portion was so altered as to be soluble in alcohol. The cellulose fraction also suffered particularly at the higher temperature (*18*). It appears that during the aqueous prehydrolysis the lignin fraction underwent a radical change, as evidenced by a greater solubility on treatment with alcohol and alkali, than when no pressure cooking was applied (*19*). Besides the hydrolysis of the pentosans, the linkages between lignin and some hemicellulose fractions may have been ruptured in the prehydrolysis. Hence, in the subsequent extraction with alcohol and alkali both pentosans and lignin are removed (*19*).

Precooking of hardwoods with water with subsequent alkaline pulping and bleaching of the product has resulted in pulps of high purity. Thus Sirakoff (*20*) on applying soda pulping to water precooked beechwood obtained fibers with 4% pentosan and 97% alpha-cellulose content in 33% yield. Ploetz (*21*) produced from beechwood by a similar process, fibers containing 2.6 to 2.7% pentosans in 32 to 34% yield. Similarly Schütz and Sarten (*22*) obtained from beech and birch woods, pulps in 33 to 35% yield with 95 to 96% alpha-cellulose and 2 to 3.5% wood gum content. From a hardwood mixture (predominantly birch with some maple and beech) McKinney (*6*) derived fibers containing 4% pentosans in 43% yield. On further bleaching and cold alkaline refining the resultant pulps contained 1.3% pentosans and 98.8% alpha-cellulose. Horio, Fukuda, Yamashita, and Tatsumi (*23*) claimed to have produced pulps suitable for the production of viscose rayon from larch wood by precooking with water, subsequent sulphate pulping and bleaching, in 33% yield, containing 2.2% pentosan and 95.5% alpha-cellulose.

PROBLEM AND OBJECT OF INVESTIGATION

By heating eucalypt woods with water, organic acids of a comparatively low pH were formed. These acids may facilitate a more even and thorough hydrolytic breakdown of the pentosans and chemical modification of the lignin-complex than when a mineral acid solution is applied.

The mineral acid has to penetrate into the cell wall to cause the hydrolytic changes and may not be as even or uniform in its action as the organic acids formed *in situ* in the cell wall of the woody tissue. In addition it was assumed that by performing the sulphate pulping under relatively mild conditions, the resultant fibers may be more uniform in their physical structure and of such purity that an additional cold alkaline purification will not be needed. The cold alkaline purification process possibly suffers from two disadvantages relative to high alkali input combined with the economy of efficient alkali recovery (*24*) and reversal of reactivity of highly swollen cellulose fibers on drying at higher temperatures (*25, 26, 27, 28, 29, 30*).

The main object of the present investigation was to produce from eucalypt woods pure and uniform (reactive) pulps by precooking with water followed by sulphate pulping and multistage bleaching but without cold alkaline purification of the derived fibers. A further object was to investigate the changes occurring in the wood as a result of precooking with water under pressure. Finally a chemical study was made of the pulped fibers both unbleached and bleached.

EXPERIMENTAL

The woods used in the experiments were as follows: (1) a mixture of different eucalypt species from Australian Paper Manufacturers Ltd., Maryvale Mill, Victoria, Australia, designated as "mixed species"; (2) and (3) two *Eucalyptus regnans* samples (46S113 and 48S163) of different forest origin and different age. The former sample originated from 80 to 100 year old and the latter from 30 year old trees.

The woods were chipped, and the chips sorted by hand and then screened over a half inch wire mesh to obtain a uniform size. Some chemical characteristics and properties of the wood samples are listed in Tables I and II.

The pulping liquor was prepared from commercial grade sodium sulphide and made up to 22% sulphidity.

Chlorine water, made in the laboratory by the customary method, and solutions of commercial grade bleaching powder (calcium hypochlorite) were applied

Table I. Properties of Eucalypt Wood Samples and Precooked Woods

Characteristics	*Wood samples*		*Precooked wood*	
	46S113	*48S163*	*47C138*	*48C163 & 164*
Xylan, %	17.4	18.1	5.1	5.2
Lignin, %	17.2	18.7	28.4	31.9
Solubility in boiling *N*/8 NaOH solution, %	14.3	15.0	..	...
Xylan removed by boiling *N*/8 NaOH solution, %	2.8	2.7	...	...
Solubility in organic solvents, %	2.5	3.2	12.3	16.3
Xylan removed by organic solvents, %	...	...	1.3	1.7
Lignin content of organic solvents extracted residue, %	21.0	21.6	23.9	25.0
Solubility in cold 5% sodium hydroxide solution, %	11.4	12.8	20.1	24.7
Difficulty soluble xylan fraction, %	14.3	14.7	1.5	1.3
Xylan removed by cold 5% sodium hydroxide solution, %	3.1	3.4	3.6	3.9
Solubility in hot water, %	3.9	3.9	...	...
Total removal by hot 2% sodium hydroxide solution (2 hr.), %	13.5	15.1	36.3	42.8
Xylan removed by hot 2% sodium hydroxide solution (2 hr.), %	3.5	3.2	3.7	3.8
Lignin removed by hot 2% sodium hydroxide solution (2 hr.), %	...	...	19.7	24.3
Total removal by hot 2% sodium hydroxide solution (24 hr.), %	17.7	19.2	52.3	57.8
Xylan removed by hot 2% sodium hydroxide solution (24 hr.), %	4.8	5.0	4.3	4.5
Lignin removed by hot 2% sodium hydroxide solution (24 hr.), %	...	...	23.6	28.5
Total removal by hot 1% hydrochloric acid solution (2 hr.), %	11.5	12.8	...	...
Xylan removed by hot 1% hydrochloric acid solution (2 hr.), %	4.9	4.9	...	...

for bleaching. The bleached pulps were washed with filtered tap water.

Apparatus and Procedure

The precookings were performed in a stainless steel lined, cylindrical, stationary digester, provided with preheater and circulating pump.

Table II. Yield and Properties of Holocellulose Fraction of Eucalypt Wood Samples

Characteristics	*Wood samples* 46S113	48S163
Yield of holocellulose[a], %	82.3	81.5
Lignin in holocellulose, %	3.8	3.8
Xylan in holocellulose, %	19.9	21.0
Xylan lost in holocellulose isolation, %	0.8	0.4
Solubility of holocellulose in hot 1% sodium hydroxide solution, %	27.4	30.3
Xylan removed from holocellulose by hot 1% sodium hydroxide solution, %	7.9	8.3
Solubility of holocellulose in cold 5% sodium hydroxide solution, %	34.8	39.2
Difficultly soluble xylan fraction in holocellulose, %		
Xylan removed from holocellulose by cold 5% sodium hydroxide solution, %	4.5 15.4	3.8 17.2

[a] Based on original wood, i.e., 17.7% material was removed from the wood sample 46S113 in both operations, i.e., extraction with organic solvents and treatments with sodium chlorite.

The wood chips were packed into the digester and covered with a perforated stainless steel plate to assist an even distribution of the liquor. During the period of heating the charge to the predetermined temperature, air was relieved from the digester. At the end of the precooking stage the pressure was slowly lowered, the hydrolysate drained off, and the charge was rinsed with water on a screen.

The precooked chips were pulped by the sulphate process in a mild steel, rotary digester provided with indirect heating.

The sulphate pulp produced was first disintegrated and washed free of black liquor over a 0.01-inch flat screen with further screening on a vibratory type of fiber sorter consisting of a flat screen of 0.006-inch cut, which was followed by collecting the pulp on a 150-mesh wire.

For the low density chlorination a cylindrical vat provided with an agitator was used. The chlorine water was introduced into the pulp stock by means of a glass tube. For the hypochlorite bleaching at high consistency a dough-mixer unit was used and the stock hypochlorite solution was added dropwise to the alkaline buffered pulp stock.

In the cold alkaline refining experiments the dough mixer was used, and a stock alkaline solution was added to the pulp in a similar manner to that in the hypochlorite treatment.

All other details of precooking, pulping, bleaching, and cold alkaline refining operations are listed in the relevant tables below: water precooking and sulphate pulping conditions are shown in Table IV, bleaching operations in Table V, and cold alkaline refining conditions in Table VI.

Analysis and Testing

Woods and Water Precooked Woods. The wood samples were ground in an attrition mill and the resultant wood used was sieved, the −40+60 mesh fraction being collected for analysis.

The analytical and testing methods applied as well as the interpretation of certain characteristics of the wood samples may be described as follows.

The lignin content of wood was determined by the customary sulphuric acid method. Before the application of 72% sulphuric acid, the test sample was refluxed with $N/8$ sodium hydroxide solution for 1 hour, washed thoroughly with water, and dried to constant weight. The loss in weight on extraction with the $N/8$ alkali solution is recorded in the relevant table below as well as the fraction of xylan removed in this extraction. This value was derived from the xylan content of the wood and that of the alkali extracted residue.

In determining the lignin content of water precooked woods the extraction with alkali prior to the application of sulphuric acid was omitted.

Solubility in organic solvents was determined according to the methods used at the Forest Products Laboratory (*31*), but a second extraction was given to the wood meal with ethanol.

The residue obtained on extraction by organic solvents was tested for xylan and lignin contents, respectively.

The pentosan content (xylan) was determined according to the method of Kröber-Tollens (*32*).

Table III. Influence of Per Cent Alkali Applied in Sulphate Pulping Stage to Water Precooked Eucalypt Woods on Pulp Yield and Characteristics of Pulps

% NaOH on oven-dry water precooked wood	*Characteristics of pulp* — *Yield, % on wood*	*Pentosans, %*	*Permanganate No. (TAPPI)*	*Viscosity in cupram., cp.*
30	31	2.8	5.0	487
23.5	36	2.8	6.5	953
20	35	2.6	7.8	1240
19	35	2.8	10.8	1508

Wood: "Mixed Species" eucalypt

Precooking stage:	
Liquor ratio	5:1
Time schedule	$^1/_2 + 3$
Pressure	85 p.s.i. (164°C.)
Yield	79% (approx.)
pH of hydrolysate	3.5
Sulphate cooking stage:	
Liquor ratio	5:1
Time schedule	$1^1/_2 + 1^1/_2 + 3$
Pressure	45 p.s.i. (145°C.)

Solubility in cold 5% sodium hydroxide solution was determined by treating a test sample of 2.5 grams air-dry with 100 ml. of the alkali solution at 20°C. for 2 hours. After filtration through a sintered glass crucible the insoluble residue was washed with water, followed by dilute acetic acid and water, and dried in an oven at 105°C. for 2 to 3 hours. The per cent loss in weight is designated as "Solubility in Cold 5% Sodium Hydroxide Solution." The insoluble residue was further tested for pentosan content and the corresponding values are designated as "Difficultly Soluble Xylan Fraction" and "Xylan Removed by Cold 5% Sodium Hydroxide Solution."

The solubility in hot water was determined by refluxing a test sample of 1 gram air-dry with 300 ml. of

water on a sand-bath for 1 hour. At the conclusion of the digestion the insoluble residue was collected on a tared alundum crucible, washed with hot water, dried at 105°C., and weighed.

Total removals by hot 2% sodium hydroxide solution were determined by refluxing a test sample of 2 grams

The holocellulose fraction was isolated according to the method of Wise, Murphy, and D'Addiecco (*33*). The wood meal was extracted with alcohol-benzene followed by ethanol before the three chlorite treatments.

The xylan and lignin contents of the holocellulose fraction were determined as described above.

Table IV. Conditions Applied in Water Precooking and Sulphate Pulping Stages, Pulp Yield and Characteristics of Sulphate Pulps

Wood sample	*Precook No.*	*Precooking conditions[a] pressure, p.s.i.*	*Yield of precooked wood, %*
48S113	47C119 and 47C138	95	78
48S163	48C163 and 48C164	97	82

Wood sample	*Precook No.*	*Sulphate pulp No.*	*Sulphate pulping conditions[b]*			
			NaOH on precooked wood, %	*pressure, p.s.i.*	*Time schedule, hr.*	*Yield of sulphate pulp, %*
46S113	47C118	47K134 and 137	20	60	$^3/_4 + ^3/_4 + 2^1/_2$	32
46S113	47C138	47K143	18	45 then 60	$^1/_2 + 1^1/_2 + 1$ then $^1/_2 + 1$	
48S163	48C163\ 48C164/	48K167	20	45 then 60	$^1/_2 + 1^1/_2 + 1$ then $^1/_2 + 1$	32.5

Sulphate pulp No.	*Characteristics*			
	Lignin, %	*Permanganate No. (TAPPI)*	*Xylan, %*	*Viscosity in cuprammonia, cp.*
47K134 and 47K137	1.9	8.0	1.9	1512
47K143	1.8	7.0	1.5	3402
48K167	1.7	7.8	1.4	7224

[a] Wood-water ratio: 1:4, time schedule: $^1/_2 + 3$ hr., e.g., $^1/_2$-hr. to pressure and 3 hr. at pressure.
[b] Precooked wood—liquor ratio: 1:4; sulphidity of cooking liquor: 22%; time schedules: $^3/_4$ hr. relief, $^3/_4$ hr. to pressure and $2^1/_2$ hr. at pressure; $^1/_2$ hr. relief, $1^1/_2$ hr. to pressure, 1 hr. at pressure (45 lb.), $^1/_2$ hr. to pressure and 1 hr. at pressure (60 lb.).

air-dry with 300 ml. of the alkali solution at 90°C. for 2 and 24 hours, respectively. At the end of the heating period the procedure was the same as that applied in the determination of the "Solubility in Cold 5% Sodium Hydroxide Solution." The residues were tested for xylan content.

Table V. Conditions Applied in Bleaching and Characteristics of Bleached Eucalypt Celluloses

Sulphate pulp No.	*Bleach No.*	*Bleaching conditions[a]*		
		Stage I,[b] Cl, %	*Stage II,[c] NaOH, %*	*Stage III,[d] Cl, %*
47K134 and 47K137	47B18	2.75	2	0.4
47K143	47B20	4.0	2	0.8
47K167	48B132	3.0	2	0.5

Bleach No.	*Characteristics of bleached pulps*			
	Xylan, %	*Resistant xylan, %*	*Alpha-cellulose, %*	*Viscosity in cuprammonia, cp.*
47B18	1.6	1.3	90.6	67.2
47B20	1.5	0.9	93.4	79.8
48B132	1.8	1.0	95.5	92.4

[a] In all bleaches the pulp, after the alkaline extraction stage, was washed with water, followed by a treatment with dilute chlorine water (0.2% chlorine on the pulp weight) and a final washing with water (*35*).
[b] In the bleaches 47B18 and 47B20 the pulp stock concentration was 4 to 4.5% while in 48B-132 it was 2.8%. The percentage chlorine refers to oven-dry weight of pulp applied and chlorine water was used in this stage at 20 to 22° C.
[c] The pulp concentration in this stage was 8 to 10%, the temperature 50 to 60°C. and the extraction period 2 hours.
[d] The pulp concentration in this stage amounted to 8 to 10% and the temperature 32 to 35°C. The pulp stock was "buffered" by adding dilute alkali solution and maintaining it at pH 9 to 10.

Total removal by hot 1% hydrochloric acid solution was determined in a similar manner applying acid solution instead of alkali for 2 hours. The xylan content of the insoluble residue was subsequently determined.

Solubility of holocellulose in cold 5% sodium hydroxide solution, difficultly soluble xylan fraction of holocellulose, xylan removed from holocellulose by cold 5% hydroxide solution, solubility of holocellulose in hot 1% sodium hydroxide solution, and xylan removed from holocellulose by hot 1% sodium hydroxide solution were determined and derived in a similar manner as described above for wood.

Table VI. Conditions of Cold Alkaline Refining of Bleached Eucalypt Celluloses and Characteristics of Celluloses before and after Alkaline Refining

Cellulose	*Characteristics*			
	Xylan, %	*Resistant xylan, %*	*Alpha-cellulose, %*	*Viscosity in cuprammonia, cp.*
Before cold alkaline refining (47B18)	1.6	1.3	90.6	67.2
After cold alkaline refining	1.0	0.9	95.2	58.8

Cold alkaline refining conditions:[a] 10% pulp stock concentration, 20 to 25°C., 2 hr. and 100% NaOH on the weight of pulp.

[a] The cold alkaline purified celluloses were washed and treated in a similar manner to the hot alkaline extracted pulps described in the appendix to Table V (*35*).

Pulps. The characteristics of unbleached and bleached pulps were determined according to methods described earlier (*34, 8*).

Processing Variables

In the preliminary experiments applying chips of the "mixed species eucalypt woods" the percentage alkali in the sulphate pulping stage was varied.

In the main experiments the *Eucalyptus regnans* samples were used and the influence of processing variables was not studied.

RESULTS AND DISCUSSION

The results are given in the tables and some are shown in Fig. 1 in which the characteristics of sulphate

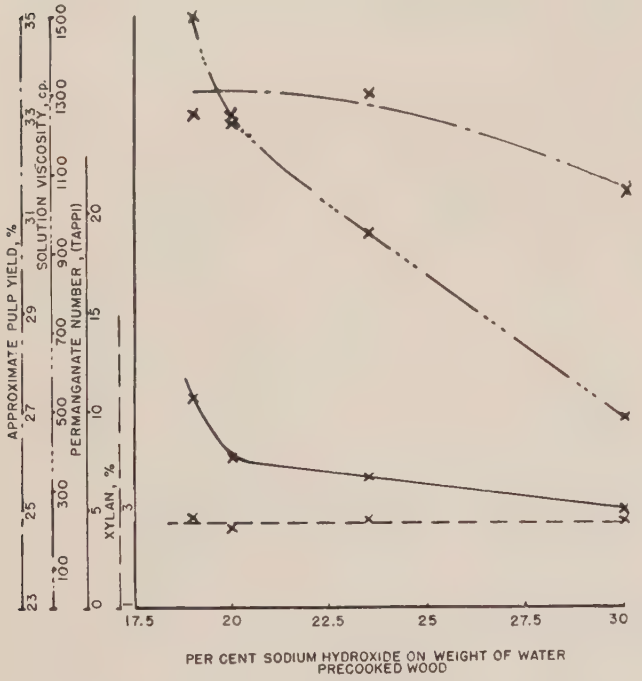

APPROXIMATE PULP YIELD, %
SOLUTION VISCOSITY, cp.
PERMANGANATE NUMBER, (TAPPI)
XYLAN, %
PER CENT SODIUM HYDROXIDE ON WEIGHT OF WATER PRECOOKED WOOD

Fig. 1. Influence of per cent alkali applied to water precooked mixed species eucalypt wood on properties of derived sulphate pulps

pulps are plotted against per cent sodium hydroxide applied in the pulping stage. The sulphidity of the cooking liquor was 22%; the wood chips were precooked at 85 p.s.i. for $^1/_2 + 3 + {}^1/_2$ hours, and the sulphate pulping was performed by applying a time schedule of $^1/_2 + {}^1/_2 + 3$ hours at 45 p.s.i. pressure.

Influence of Alkali Concentration in the Sulphate Pulping Stage Applied to Water Precooked Eucalypt Woods.

In the preliminary experiments applying "mixed species woods" the conditions of precooking were constant, and the alkali percentage in the sulphate pulping stage was the variable. Increasing alkali concentration decreased the pulp yield, bleachability (permanganate number), and solution viscosity of the pulps. The xylan content of the pulps was practically the same, i.e., irrespective of the percentage alkali applied in the sulphate pulping stage within the investigated range of alkali concentration.

Changes Taking Place with Eucalypt Woods on Precooking with Water.

It was not intended to study the changes of fundamental nature occurring in the chemistry of the woods, but to show the difference in some chemical characteristics before and after water precooking. However, the characteristics shown in Tables I and II may serve to evaluate the quality and suitability of woods for pulping. The usefulness of the methods and interpretations will be described elsewhere.

The most striking changes during the precooking step appear to be in the pentosan and lignin fractions. The pentosans are largely hydrolyzed and dissolved. Those remaining in the precooked wood are readily removed by hot alkali solutions. These changes are reflected in the decreased "difficulty soluble xylan fraction" when compared with that of the original woods. The lignin fraction has not suffered a significant change in quantity in the prehydrolysis. The ease of delignification of the water precooked woods by hot alkali solution may also be indicative of considerable changes which have taken place in the physical and/or chemical constitution of the lignin fraction of the wood. This ease of delignification would be concordant with the contention of the presence of a lignin-hemicellulose complex in the wood (*19*). By hydrolytic action this complex may be split in the water precooking stage rendering both the lignin and pentosan fractions reactive and easily removable by hot alkali solutions.

The solubility in organic solvents of the water precooked woods was much higher than that of the parent woods. The portion soluble in organic solvents is not composed of much pentosan materials. By taking into consideration the material loss and lignin values, it seems to be composed mainly of lignin, or possibly a condensation product or a depolymerization product (*18*) formed in the precooking and behaving like lignin insofar as it is insoluble in 72% sulphuric acid.

Both *Eucalyptus regnans* samples used in this investigation showed similar characteristics, but the younger wood sample seemed to have a less resistant xylan fraction and a cellulose fraction of greater resistance to hydrolytic degradation and to the peptizing action of cold alkali solution. The differences are slight but prevail after water precooking or after chlorite treatment (Tables I and II). These differences between the fibers of the two wood samples are also reflected in the characteristics of the unbleached and bleached pulps (Tables IV and V).

Purity of Eucalypt Celluloses Produced by Water Precooking Followed by Sulphate Pulping and Bleaching.

By applying water prehydrolysis to eucalypt wood chips under pressure (95 to 100 p.s.i.) followed by sulphate pulping under relatively low pressure, pulps were produced of low bleachability (1 to 2% lignin content and 6 to 8 permanganate number) and low pentosan content (1.5 to 2%) in 32 to 34% yield. Bleaching of these pulps by multistage chlorine bleaching methods resulted in cellulose fibers with 1.5% total and about 1% resistant pentosan contents, accompanied by 95 to 96% alpha-cellulose content. Thus, the main object of the present investigation has been achieved since the production of hardwood celluloses of such purity had only been obtained by the application of the cold alkaline purification process. Some cold alkaline refining experiments performed on these pure eucalypt pulps showed that the "resistant pentosan fraction" remained unchanged and that a further decrease in the total pentosan content can be achieved (Table VI). Less than 1% pentosan can hardly be expected, because this pentosan content is likely to be only apparent and may be attributed to the inherent error in the customary analysis. The "resistant xylan content" of the order of 1% in the pure eucalypt pulps may similarly be apparent since these reactive fibers may yield hydroxymethyl furfural arising from cellulose in the customary distillation with 12% hydrochloric acid and are in-

terpreted as pentosan (*8*). The celluloses obtained by the process described in this paper resemble high quality softwood dissolving pulps when their degree of purity is considered. The reactivity and uniformity will form the subject of a later paper.

SUMMARY AND CONCLUSIONS

1. A mixture of species of eucalypt woods precooked with water at 85 pounds pressure, followed by sulphate pulping at 45 pounds pressure, applying 19 to 30% alkali, resulted in pulps with practically the same xylan content of 3 to 2.8 per cent. The percentage alkali, applied in the sulphate pulping stage, however, had a significant influence on pulp yield, bleachability, and solution viscosity of the derived pulps.

2. *Eucalyptus regnans* samples precooked with water at temperatures corresponding to 95 to 100 pound pressures, showed a low pentosan content and only a slightly changed lignin content when compared with the parent woods. (Pentosan content of woods: 18%; that of the water precooked woods: 5%).

The lignin-carbohydrate complex may have undergone considerable changes during the precooking with water when organic acids were formed, as evidenced by the ease of removal of lignin and pentosans from the precooked woods by hot alkali solution and by the increased quantity of organic solvent extractables.

The "difficulty soluble xylan fraction" (xylan insoluble in cold 5% sodium hydroxide solution) of the water precooked woods was lower than that of the parent woods which is indicative of extensive changes occurring during water precooking.

3. *Eucalyptus regnans* wood chips precooked, with water at 95 to 100 pounds pressure, followed by sulphate pulping, applying 18 to 20% alkali for a period at 45 pounds pressure and for a subsequent period at 60 pounds pressure, resulted in pulps of low lignin and pentosan and high alpha-cellulose content in 32 to 33% yield based on the weight of original wood.

On bleaching the cellulose pulps by a three-stage bleaching process pure cellulose fibers were produced without the application of cold alkaline purification. Such pulps had 1.5 to 1.8% total, and 1% "resistant" pentosans, and 93 to 96% alpha-cellulose contents. This degree of purity of the hardwood pulps resembles that of high quality, dissolving grade softwood pulps.

Patent applications have been filed covering some features of the process described in this paper.

LITERATURE CITED

1. Tasker, C. W., and Libby, C. E., *Tech. Assoc. Papers* 29: 419 (1946), including further references pertaining to pulping processes of hardwoods and chemical refining of hardwood pulps.
2. Klauditz, W., *Holz als Roh-und Werkstoff* 4: 314 (1941).
3. Richter, G. A., *Ind. Eng. Chem.* 33: 1518 (1941).
4. Rosenberg, N. A., *Zellstoff u. Papier* 21: 184, 210 (1941).
5. Lindpaintner, E., *Melliand Textilber.* 23: 229 (1942).
6. McKinney, J. W., *Paper Trade J.* 122, No. 4: 58 (1946).
7. Correns, E., *Cellulosechem.* 19: 105 (1941).
8. Meller, A., *Tech. Assoc. Papers* 30: 214 (1947).
9. Richter, G. A., U. S. pat. 1,787,953 (1931); 1,880,043 (1932).
10. Jayme, G., and Schorning, P., *Holz als Roh-und Werkstoff* 3: 273 (1940).
11. Jayme, G., *Papier-Fabr.* 38: 277 (1940); 39: 161 (1941).
12. Cornell, L. W., and Montonna, R. E., Canadian pat. 398,573 (1941).
13. Schieber, W., *Wochenbl. f. Papierfabr.* 72: 575 (1941).
14. Correns, E., and Schorning, P., *Cellulosechem.* 20: 29 (1942).
15. Ploetz, T., *Papier-Fabr.* 41: 17 (1943); *Cellulosechem.* 21: 14 (1943).
16. Dörr, E., *Papier-Fabr.* 39: 267 (1941).
17. Zellstoff Fabrik Waldhof, French pat. 875,279.
18. Aronowsky, S. I., and Gortner, R. A., *Ind. Eng. Chem.* 22: 264, 941 (1930).
19. Overbeck, W., and Müller, H. F., *Ber.* 75: 547 (1942).
20. Sirakoff, G., *Holz als Roh-und Werkstoff* 4: 205 (1941).
21. Ploetz, T., *Holz als Roh-und Werkstoff* 4: 380 (1941).
22. Schütz, F., and Sarten, P., *Cellulosechem.* 21: 35 (1943).
23. Horio M., Fukuda, Y., Yamashita, S., and Tatsumi, M., *J. Soc. Chem. Ind. Japan* 47: 126 (1944).
24. Jayme, G., *Paper Maker* 44: 184 (1937); 45: 3 (1938).
25. Faust, O., Celluloseverbindungen und ihre besonders wichtigen Verwendungsgebiete. Reproduced by Edwards Bros. Inc., Ann Arbor, Mich.
26. Staudinger, H., *J. prakt. Chem.* 161: 219 (1943).
27. Hubert, E., Matthes, A., and Weisbrod, K., *Kolloid, Z.* 98: 173 (1942); 108: 79 (1944).
28. Meller, A., *Tech. Assoc. Papers* 30: 317 (1947).
29. Jayme, G., *Cellulosechem.* 21: 73 (1943).
30. Assaf, A. G., Haas, R. H., and Purves, C. B., *J. Amer. Chem. Soc.* 66: 59, 66 (1944).
31. U. S. Forest Products Laboratory, "Methods Used at the Forest Products Laboratory for Chemical Analysis of Pulps and Pulp Woods," compiled by Mark W. Bray, 1939.
32. Doree, Ch., "The Methods of Cellulose Chemistry" 2nd Ed., Chapman & Hall, London, 1946.
33. Wise, L. E., Murphy, M., D'Addiecco, A., *Tech. Assoc. Papers* 29: 210 (1946).
34. Meller, A., *Tech. Assoc., Papers* 29: 642 (1946).
35. Australian Paper Manufacturers Limited, Australian pat. 116, 441 (1943).

Received Aug. 24, 1949.

Appreciation is due to Australian Paper Manufacturers Limited, for permission to publish this paper.

The experiments and analyses described in this paper were performed by Miss K. M. Goble, K. C. Carolane, K. W. Laws, and J. G. Taylor, Assistant Research Chemists, Australian Paper Manufacturers Ltd., Melbourne, Australia.

Enzyme Conversion of Starch for Paper Coating

D. A. HUGHES and W. L. CRAIG

This paper deals with the methods of preparing starch pastes for paper machine coating by enzyme conversion. A brief background in enzymology is presented to acquaint the reader with the reasons for the techniques recommended to facilitate the best conversion products. Two conversion processes are described and the optimum operating condition for each is illustrated. The advantages of this type of starch paste preparation are discussed.

D. A. Hughes and W. L. Craig, Paper Mill Dept., R. T. Vanderbilt Co. Inc., New York, N. Y.

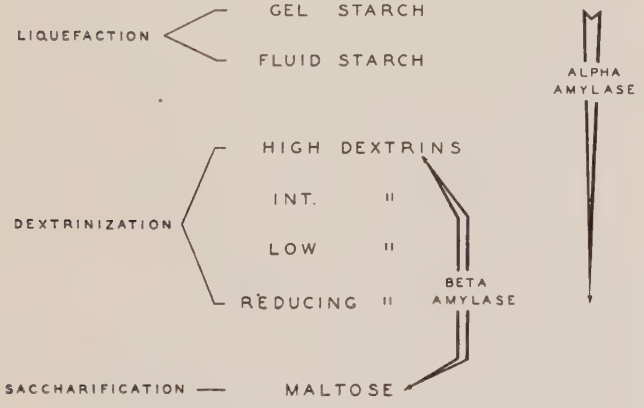
Starches are widely used in the paper industry for sizing, laminating, and as adhesives in paper coating colors. To be suitable for such uses, starch dispersions must have the required adhesive strength and must be sufficiently fluid to flow at the desired concentrations and temperatures. Untreated gelatinous starches, as a rule, have good adhesive strength but are far too viscous at the concentrations required for most uses. Therefore, starch dispersions must be treated in some

manner to reduce their viscosity without excessively reducing their bonding strength. This liquefaction may be accomplished by enzyme conversion.

Enzymes may be defined as biocatalysts. They are organic substances produced by living matter which have the ability to accelerate specific chemical changes without themselves undergoing any change. In general their name is an indication of the specific reaction for which they are used. Thus, the enzyme which functions with the substrate amylum (starch) is termed "amylase."

AMYLASE, TYPES AND PROPERTIES

Amylase, in general, is considered to be divided into "alpha" and "beta" components. The alpha component, when used alone, effects the liquefaction and dextrinization of gelatinized starch with a minimum amount of saccharification. Beta amylase, in the absence of the alpha component, causes some dextrinization and considerable saccharification. The actions of the amylases are illustrated as follows:



Enzymic degradation of starch

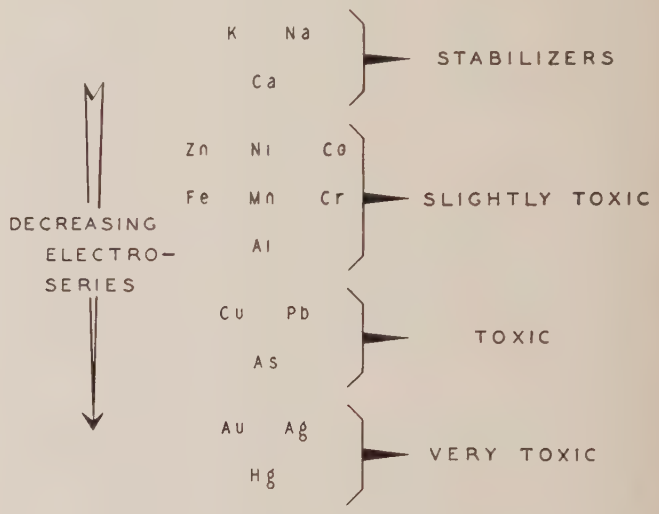
The alpha amylase initially attacks specific linkages and reduces the starch granule into smaller physical units with an inappreciable amount of dextrinization. Upon completion of this initial cleavage the starch molecules are split into dextrins of very high complexity which yield substantially no change in the typically blue starch-iodine coloration. Allowing further action facilitates the progressive formation of less complex dextrins which stain purple with iodine, then red, and finally reach the achromic point yielding no color whatever.

Although, characteristically, alpha amylase accomplishes its action with saccharification well in the minor role, appreciable maltose will be formed should the degradation be permitted to progress to the reducing dextrin stage. Adhesive-wise, the reaction should be terminated at the initiation of the intermediate dextrin formation since beyond this point the bonding strength begins to suffer markedly.

A mixture of alpha and beta amylase causes a rapid degradation of the starch to low dextrins and maltose having very little adhesive value.

Practically all amylases on the market today, which are sold to the paper industry, consist of the high-purified bacterial alpha type which, under specified conditions, allow maximum starch viscosity reduction with a minimum loss in bonding strength.

The activity of amylase depends upon a number of factors. One such factor involves the effect of cations on the enzymes' action. In general, the electromotive series is an index of the toxic degree of the cations. The metals at the top of the series show stabilizing properties while those on the low end exhibit very highly toxic effects. Needless to say, ions occupying these lower positions must be kept out of any starch conversion system except for intentional inactivation purposes. It is generally accepted that the metals occupying the top positions appear to activate by increasing the stability of the enzyme as a function of the other properties of the system. Thus, by actually retarding inactivation, they allow the enzyme to operate at its original activity for a longer period of time. Most of the present-day enzymes are sold containing an optimum amount of a soluble salt of one of these metals which not only effects the above mentioned but aids in the peptization of the enzyme in the water phase.



Cation effect on enzyme activity

A second, and considerably more complicated factor embraces the interrelation of amylase activity and stability with the pH and temperature of the medium. Alpha amylase can be completely destroyed by heat and by adverse pH conditions. Generally, alpha amylase exhibits maximum stability at room temperatures in a pH environment of 6 to 8. The alpha amylase becomes more stable to heat as the pH of the medium is adjusted from the acid side to neutrality. In all conversions at higher temperatures, serious consideration must be given to the heat-stabilizing properties of higher pH values.

In view of the fact that negligible enzymic degradation occurs until gelatinization has been effected, it is found most advantageous, for the sake of operational simplicity, to conduct the liquefaction in the proximity of the gelatinization temperature. A temperature of 170°F. not only satisfies this condition but seems to allow for better mixing and thermal transfer than the actual gelatinization temperature itself. A typical pH range for conversion at this temperature using a commercial alpha amylase is given in Fig. 1.

ENZYME CONVERSION

The actual conversion or "cooking" of the starch is carried out according to a definite and predetermined time cycle and at a constant rate of agitation since both of these have a definite effect on the viscosity of the end product. Figure 2 shows a recommended time-temperature cycle for proper conversion.

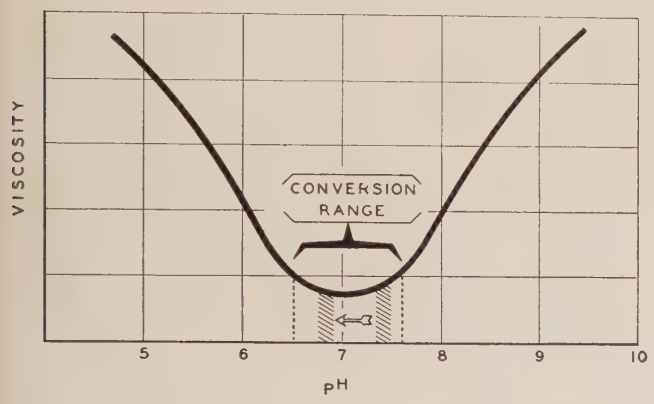


Fig. 1. Optimum pH for (Vanzyme) conversion at 170° F.

The actual degradation of viscosity reduction occurs primarily during the 30-minute holding period at 170°F. After this period, the processing must then be terminated by some action which renders the enzyme subsequently ineffective. This may be done by one of two methods.

The first, and by far the most common, embraces the raising of the batch temperature sufficiently to effect an irreversible instability loss of all of the enzyme. This is defined as "heat inactivation." The second method, called "chemical inactivation" involves the addition of some agent which is highly toxic to the enzyme's catalytic properties to the batch.

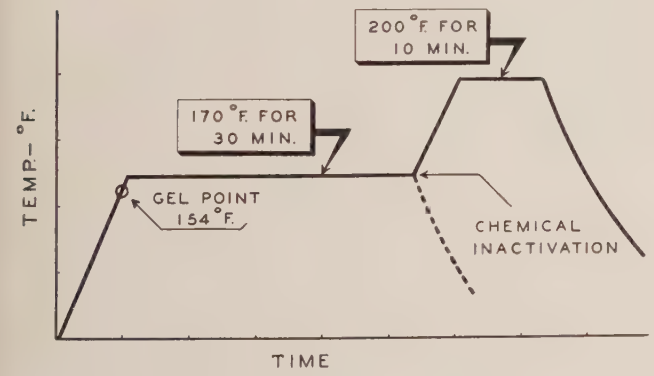


Fig. 2. Conversion cycle

Probably the most frequently asked question concerning the time-temperature cycle is the justification of the 30-minute holding period. What about the use of more enzyme and cut back on the conversion time? Aside from the fact that such a procedure would substantially increase the cost of enzyme per pound of coating, it will be found that the entire operation must be more closely controlled to yield coatings, the viscosity of which, batch after batch, fall within operational specification brackets set up previously. All in all, conversion period length depends entirely upon the individual coating operation. The more competent the formulation personnel, the more accurate the automatic cooking equipment, and the wider the allowable limits of the finished color's rheological properties for machine operation, the shorter the conversion time allowable. It has been found through experience that a conversion designed to operate on a 30-minute holding period generally yields batch after batch within the specifications of the average machine using average cooking equipment and personnel.

PROPERTIES OF COATINGS MADE FROM ENZYME CONVERTED STARCH

For the systematic study of coating color preparations, the R. T. Vanderbilt Co. constructed a small pilot plant with two 150-gallon stainless steel tanks completely engineered to control the numerous variables encountered. The entire operation—including rate of temperature increase, holding and inactivation times, temperatures, and desired product viscosity—is predetermined and set on the large control panel so that the entire conversion is completely and automatically controlled by an electronic control mechanism. At the completion of the time cycle the controller automatically shuts off, and the color is completely finished to the desired viscosity and machine temperature. The work reported in this discussion was conducted in this equipment.

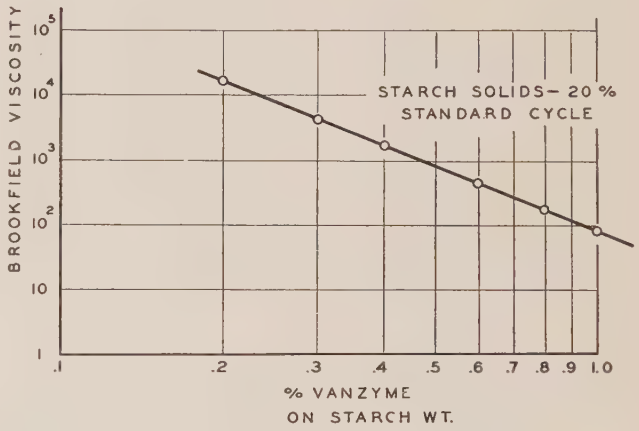


Fig. 3. Viscosity of starch conversions

Of considerable interest to the coated paper industry is the interrelation of the percentage enzyme used and per cent solids of the starch conversions with the resulting paste and color viscosities and wax tests. Figures 3, 4, and 5 illustrate a correlation of these factors. In all of the work shown the standard time cycle as in Fig. 2 was used, and all viscosity measurements were made at 80°F. using a Brookfield viscometer (100 r.p.m.).

Figure 3 illustrates the relationship between paste viscosity and percentage enzyme using a starch cook at 20% solids. It will be noted that the plot is logarithmic, and that the end viscosity of a cook converted with 0.2% enzyme is roughly 100 times the viscosity of a cook employing 0.8% enzyme.

Forty per cent solid coatings were made from the cooks in Fig. 3, and the viscosities and final wax tests of these coatings are plotted in Fig. 4. The brightness and opacity of the coatings were equal and the Bausch & Lomb gloss showed a slight increase as the percentage of enzyme was increased. The trend in starch paste viscosity indicated in Fig. 3 is seen to have carried through into the respective coatings. As expected, the wax test is seen to decrease as the degree of conversion is increased. It is to be noted from Fig. 4 that a lowering of the viscosity and wax test occur simultaneously as the percentage of enzyme is increased. However, since the decrease in viscosity is essentially exponential, a relatively low-viscosity coating is obtained at a somewhat low-enzyme concentration. The drop in wax test is essentially linear. A comparison of the two curves indicates that the maximum viscosity drop may be obtained without forcing the wax test to an extremely low value.

Figure 5 illustrates the correlation of coating color viscosity and wax test with the concentration of the starch conversions. The viscosities of the finished starch conversions are plotted for comparative purposes, and these describe an exponential curve dropping from 8000 cp. at the 40% concentration to 32 cp. at the 10% concentration. The coating color viscosity and wax test values are lower in the high solids conversions indicating that the degree of conversion was greater even though the amount of enzyme, percentagewise, was the same in all cases. To fully explain this requires reference to the kinetics of enzyme actions but briefly, the rate of enzyme action is proportional to the concentration of both the enzyme and the starch throughout a major portion of the conversion period. Thus, the higher the concentration of the starch, assuming the percentage of enzyme constant, the greater degree of conversion per cycle.

PREPARATION OF COATINGS

The blending of the converted starch with commonly used pigments is accomplished by the same procedure as is used for any of the paper-coating adhesives.

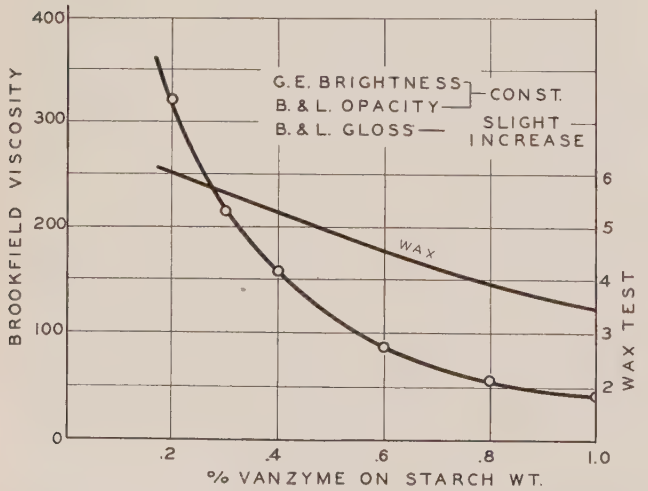


Fig. 4. Properties of 40% colors starch converted—20% solids

A process, which results in better finish properties in a calendered sheet by virtue of low adhesive to pigment ratio, involves the conversion of the starch in the presence of the pigment. This process allows the production of very high solids coatings with a minimum amount of handling and facilitates a homogeneous end product. Some pigments, such as clay, absorb protein and since enzymes are proteins they are liable to this action unless a simple precautionary measure is taken. This measure involves the treatment of the pigment slurry with an agent which will satisfy the absorption power of the pigment and usually about 1% sodium silicate (water glass), added to the dispersion water prior to the pigment addition, is effective. The silicate not only prevents absorption of the enzyme but also aids markedly the initial dispersion of the pigment, thus giving a substantial decrease in the amount of phosphate dispersants commonly used. Colors prepared in this manner result in a higher gloss finish and lower adhesive cost per pound of coating.

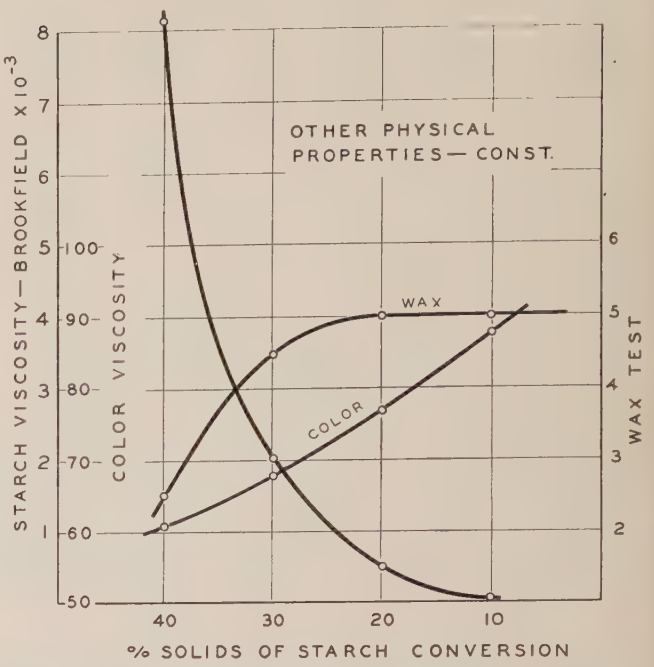


Fig. 5. Properties of 40% colors starch converted—0.6% enzyme

CONCLUSIONS

Enzyme converted starches are particularly adaptable to paper machine coating because they give maximum flexibility of the finished product's physical properties. The relationship between solids content, viscosity, and adhesive to pigment ratio is, without doubt, the major criterion of any coating color's workability on any given machine. In a good many coating color formulations, the selection of any two of these properties forces the third and a loss in some finished property is often the result of this inevitable compromise. However, it is possible to vary any or all of these three factors through surprisingly large ranges when enzyme conversion of the starch is employed. Instrumentation required for proper conversion is slight, and its cost is soon balanced by the raw material saving involved in an enzyme conversion process.

Received Feb. 12, 1950. Presented at the Annual Meeting of the Technical Association of the Pulp & Paper Industry, New York, N. Y., Feb. 20–23, 1950.

PERSONAL MENTION

Items About New and Old Tappimen

New TAPPI Members

Thomas R. Adelsperger, Instrument Maintenance, Champion Paper & Fibre Co., Hamilton, Ohio.

Sture Andre, President, Stromsnas Bruks A.B., Stromsnasbruk, Sweden, a 1918 graduate of Royal Technical University.

R. Ellsworth Annis, Jr., Mechanical Engineer, Hollingsworth & Whitney Co., Waterville, Me., a 1948 graduate of Massachusetts Institute of Technology.

Walter E. A. Axhausen, Engineer, Maschinenfabrik J. M. Voith, Heidenheim (Brenz), Germany.

J. Bertram Bates, Assistant Associate Technical Director, Sun Chemical Co., Long Island City, N. Y., a 1941 graduate of Rice Institute with a Ph.D. degree.

Carl B. Bennett, Sales Engineer, Catalin Corp. of America, New York, N. Y., a 1938 graduate of Miami University, and a 1948 graduate of Polytechnic Institute.

J. M. B. Beuker, Managing Director, Royal Paper Mills, Renkum II, Holland.

Wilson F. Brown, Chemical Engineer, Hamilton, Ohio, a 1916 graduate of Ohio State University, with a Ph.D. degree in 1928.

Donald J. Campbell, Research Supervisor, E. I. duPont de Nemours & Co., Inc., Niagara Falls, N. Y., a 1921 graduate of Philadelphia Textile School.

J. Sutton Curtis, Manager, John Dickinson & Co. Ltd., Home Park Mills, King's Langley, Herts., England.

John W. Davey, Chemical Sales, Corn Products Sales Co., Chicago, Ill., a 1945 graduate of the University of Wisconsin.

T. Everett English, Technical Sales Representative, E. I. duPont de Nemours & Co., Inc., New York, N. Y., a 1948 graduate of New York State College of Forestry.

Augustin C. Groom, Chemist, The Mead Corp., Chillicothe, Ohio, a 1931 graduate of Xavier University.

Arthur B. Harris, Jr., Sales Engineer, Snyder Chemical Corp., Bethel, Conn., a 1936 graduate of the University of Alabama.

Rune Hellerqvist, Superintendent, Ostrands AB, Timra, Sweden, a 1936 graduate of Chalmers College, Gothenburg.

John W. D. Hierlihy, Acting Mill Manager, Fraser Paper Ltd., Madawaska, Me., a 1927 graduate of Mount Allison College, Sackville, N. B., Canada.

Louis T. Ibbotson, Librarian, University of Maine, Orono, Me.

Mitsunori Iimura, Director, Nippon Art Paper Mfg. Co. Ltd., Tokyo, Japan, a 1927 graduate of Tokyo Technical College.

Bernard C. Johnson, Assistant Pulp Mill Superintendent, Detroit Sulphite Pulp & Paper Co., Detroit, Mich., a 1940 graduate of Michigan State College.

Kristian Klarfelt, Chief Engineer, A/S Thunes Mekaniska Werksted, Oslo, Norway, a 1910 graduate of Oslo Institute of Technology.

Mildred Kocic, Chemist, Hollingsworth & Whitney Co., Waterville, Me., a 1948 graduate of New York State College of Forestry.

Richard D. Lewis, General Pulp Mill Superintendent, St. Regis Paper Co., Norfolk, N. Y., a 1944 graduate of Rensselaer Polytechnic Institute.

Rodrigo Lopez, Chemist, Carton de Colombia, S. A., Cali, Colombia.

William R. Lusignea, Manager, Sales Department, Paper Manufacturers Co., Philadelphia, Pa., a 1908 graduate of Bellenden School, London, England.

Paul F. Marxov, President, Paul F. Marxov, Inc., New York, N. Y., a 1914 graduate of Munich University.

Monroe J. Mason, Section Director, Anheuser-Busch, Inc., St. Louis, Mo., a 1936 graduate of Rice Institute with an M.S. degree.

Bernhard K. Mayer, Student, New York State College of Forestry, Syracuse, N. Y.

Robert W. Miller, Research Chemical Engineer, Simpson Logging Co., Shelton, Wash., a 1936 graduate of Pennsylvania State College, with an M.S. degree from the Institute of Paper Chemistry in 1939.

Leonard T. Mygatt, Proprietor, Package Supply Co., Lansdown, Pa. Attended the University of California.

Nils P. Nilsson, Engineer, A. B. Karlstads Mekaniska Werkstad, Karlstad, Sweden.

John J. Osmar, Research Chemist, Ramie Products Corp., Callery, Pa., a 1946 graduate of St. Vincent College.

B. P. Ramakrishnan, General Manager, The Mysore Paper Mills Ltd., Bhadravati, India, a 1928 graduate of Central College, with a degree in Forestry from the University of Munich in 1933.

Albert E. Rayner, Manager, John Dickinson & Co. Ltd., Croxley Mills, Watford, Herts., England, a 1928 graduate of London School of Economics.

John W. Ridgway, Research Dept., Goods Div., Joseph E. Seagram & Sons, Inc., Louisville, Ky., a 1932 graduate of the University of Louisville, with an M.S. degree from Yale University in 1934.

James J. Sableski, Quality Control Engineer, The American Paper Goods Co., Kensington, Conn., a 1949 graduate of Massachusetts Institute of Technology.

Kikuzo Saito, Staff of Laboratory Research Section, Daishowa Paper Mfg. Co., Shizuoka Pref., Japan, a 1945 graduate of Nippon University.

Pierre Schepers, Chief Engineer, S.A. John Cockerill, Seraing, Belgium. Attended the University of Liege.

Ian P. Sim, Technical Assistant Mill Manager, Southern Kraft Div., International Paper Co., Georgetown, S. C., a 1937 graduate of the University of Florida.

Albert W. Stout, Research Chemist, Western Pine Association, Portland, Ore., a 1930 graduate of Oregon State College, with a Ph.D. degree from the University of Wisconsin in 1934.

John J. Sullivan, Jr., Student, New York State College of Forestry, Syracuse, N. Y.

Christopher B. Tabb, Chief Chemist, Cellulose Development Corp. Ltd., Hatch End, England, a 1938 graduate of Manchester University.

Kaare Ulsteen, Civil Engineer, Norsk Spraengstofindustri A.B., Oslo, Norway, a 1941 graduate of Technische Hochschule, Dresden.

Wayne Wheelhouse, Technical Director, Sitroux, Inc., New Hartford, N. Y., a 1940 graduate of the University of Illinois.

Fred E. Wintzer, Salesman, E. I. duPont de Nemours & Co., Inc., Wilmington, Del., a 1937 graduate of the University of Illinois.

Harold C. Wood, Salesman, Arnold, Hoffman & Co., Inc., Providence, R. I., a 1924 graduate of Philadelphia Textile Institute.

TAPPI Notes

Betty S. Allender, formerly Technical Director, Windsor Locks Paper Corp., is now with the Carolina Paper Mills, Inc., Rockingham, N. C. Both companies are owned and operated by the same Company.

Hector Audino, Industrial Consultant is now located at 102 Bennett Ave., Teaneck, N. J.

Raymond F. Bennett is now General Manager of the Ecusta Paper Co., Pisgah Forest, N. C. This company which is now owned by Olin Industries will soon manufacture cellophane as well as cigarette papers.

Robert E. Brown of Rayonier, Inc., has been transferred from technical sales in New York City to the Grays Harbor Division, Hoquiam, Wash., where he is Assistant to the Technical Director.

Edward T. Buchanan is now Assistant Chief Engineer, Consolidated Paper Corp., Ltd., Grand Mere, P. Q.

William Caddoo of Robert Gair Co., has been transferred from the Piermont, N. Y., mill where he was technical director to the Thames River Mill at Uncasville, Conn., where he is now Manager.

N. Wilson Cady of the U. S. Gypsum Co., has been transferred from Oakmont, Pa., to Chicago, Ill., where he is Paper Production Manager.

Henry W. Fales, formerly of the Marinette Paper Co., is now Chief Engineer, Wood Flong Co., Hoosick Falls, N. Y.

Maurice Fischer, formerly of the Agfa Ansco Corp., is now Supervisor, Film Finishing Section, General Aniline & Film Corp., Binghamton, N. Y.

Roland E. Fortier, formerly of the Brown Co., is now Pulp Mill Superintendent, Central Paper Co., Muskegon, Mich.

Geijer, Carl G., formerly with Union Bag & Paper Corp., Savannah, Ga., is now General Superintendent, Amotfors Pulp & Paper Co., Amotfors, Sweden.

Edwin A. Hanna, formerly Superintendent of the Scott Paper Co., is now with the Marinette Paper Co., Fort Edward, N. Y.

Albert M. Harper, Research Chemist of Fraser Companies Ltd., has been transferred from Edmunston, N. B., to Newcastle, N. B.

Harold E. Hitchcock, Chemical Engineer, Standard Oil Development Co., has been transferred from Elizabeth, N. J., to Linden, N. J.

William A. Kosicki, formerly of the Newport News Shipbuilding Co., is now Engineer for the Scott Paper Co., Chester, Pa.

P. M. Loddengaard is now President, United Board & Carton Co., Syracuse, N. Y.

Stephen Mahon, formerly President of Stream Clear, Inc., is now Managing Engineer, Mahon Technical Service, Chicago, Ill.

Jean Paul Rolland, formerly of the Rolland Paper Co., is now Owner of the Montreal Ruling and Bookbinding Co. Ltd., Montreal, P. Q.

P. R. Sandwell, formerly of Beecher & Sandwell is now a Consulting Engineer, 1224 Vancouver Block, Vancouver, B. C.

S. Bertil Segring, formerly of the Irish Wallboard Co. Ltd., is now Works Manager of the Board Mill, Holmens Bruks & Fabriks A/B. Vrena, Sweden.

Ellsworth H. Shriver, formerly of the Institute of Paper Chemistry is now a Research and Development Group Leader, Mead Corp., Chillicothe, Ohio.

Donald R. Simonds, formerly Chief Engineer, Gould Paper Co., is now Engineer, Beloit Iron Works, Beloit, Wis.

Donald O. White, formerly Superintendent of Control, Abitibi Power & Paper Co., is now with the Manitoba Paper Co. Ltd., Pine Falls, Man.

Roland B. Wilber, formerly of the Southern Paperboard Co., is now Manager of Potlatch Forests, Inc., Lewiston, Idaho.

Robert E. Bundy, Vice-President in charge of Production, Fibreboard Products, Inc., San Francisco, Calif., is now the official corporate representative of his Company in TAPPI, succeeding N. M. Brisbois.

Carl H. Luth has succeeded D. B. Smith as the official representative in TAPPI of the Ward Paper Co., Merrill, Wis.

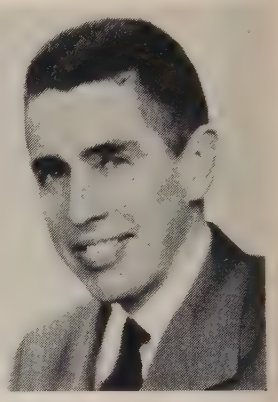
D. B. Smith is now the official representative in TAPPI of the Wausau Paper Mills, Brokaw, Wis., succeeding Eugene G. Ingalls.

Industry Notes

The Sandy Hill Iron & Brass Works, Hudson Falls, N. Y., has just issued a new, revised and expanded issue of its "Brochure of Modern Pulp and Paper Machinery." This plastic simulated leather bound book is similar to the one previously published which won the first prize for manufacturers advertising literature of the First Advertising Agency Group. In addition to photographic illustrations of machines it contains a number of useful drawings.

* * *

Buffalo Pumps, Inc., and its parent organization, Buffalo Forge Co., Buffalo, N. Y., have established a Pulp and Paper Division to better serve the increasing needs of the industry by integrating the engineering and application problems of liquid and air handling. John B. Chandler, a member of TAPPI, and formerly with the Bristol Company will manage this division.



John B. Chandler

* * *

The electric equipment for the new pulp and paper mill of Potlatch Forests, Inc., Lewiston, Idaho, will be furnished by the General Electric Co. The rated capacity of this mill, which will use mixed woods will be 150 tons per day. It is expected to start on Jan. 1, 1951. The major electric item to be supplied is a 10,000-kw., 12,500-kw. steam turbine generator set.

* * *

"Mathieson Caustic Soda," a new 48-page book is now available from the Mathieson Chemical Corp., Mathieson Bldg., Baltimore 3, Md. It is a 2-color illustrated book covering manufacture, economics, properties, handling, and application of this product.

* * *

Leonard Rockstrom, formerly director of engineering for the F. X. Hooper Co., has joined the Cameron Machine Co., Brooklyn, N. Y., as Chief Engineer. He will be responsible for all new design and development work on slitting and rewinding machinery.

* * *

The American Type Founders, Klingrose Gravure Div., 200 Elmora Ave., Elizabeth, N. J., has issued two booklets "Hourly Production Tables" and "Cylinder Calculator." These are useful in estimating rotogravure diameters for all cylinder circumferences from one to 60 inches.

* * *

Vice-Admiral Earle W. Mills has been elected President of

YOU, TOO, CAN MAKE A *CLEAN UP* WITH DIRTECS

Dozens and dozens of DIRTECS are being installed by mills of all kinds and sizes, right now. Why? Because DIRTECS provide quick, sure, inexpensive protection against competition from cleaner paper in today's choosy market.

DIRTECS get the dirt and get it out for good. They're easy to install and operate — readily adaptable to *your* dirt problem, *your* stock, *your* volume requirements.

Ask us for recommendations and estimates.

BIRD MACHINE COMPANY
South Walpole, Massachusetts

the Foster Wheeler Corp., New York, N. Y. He joined the Foster Wheeler organization early last year and succeeds Harry S. Brown (deceased). Indications are that the 1950 production of the Foster Wheeler Corp. will be about the same as it was in 1949.

* * *

David E. Davidson has been elected Vice-President for Sales of the Link-Belt Co., Chicago, Ill. Mr. Davidson has been General Manager of the Pershing Road plant in Chicago and has been succeeded in that position by E. P. Berg.

* * *

A 3-day New England Industrial Wastes Conference will be held at the Mass. Inst. of Technology, Cambridge, Mass., on June 26–28, 1950. In addition to general discussions of pollution abatement from the viewpoint of industry, control agencies, and municipalities there will be a symposium on the water and waste problems of the pulp and paper, textile, leather, food and metal industries. Professors Rolf Eliassen and C. N. Sawyer of the M.I.T. Dept. of Civil and Sanitary Engineering will be in charge.

* * *

The Improved Paper Machinery Co., Nashua, N. H., has just issued a new 16-page catalog on Pulp Handling Equipment. In addition to the Company's standard equipment, information is furnished on the valveless vacuum thickener, Waco fitter, Dunbar horizontal chipper, high-consistency pump and chip bin and distributor. Included also are lists of actual mill installations.

* * *

The paper Technology Laboratories at Western Michigan College, Kalamazoo, Mich., were dedicated on April 6th.

* * *

The Westinghouse Electric Corp., has opened a new office at Watertown, N. Y., as a step in its program of cooperating even more closely with the industry. Richard E. Fang, formerly of the Rochester office will be located at Watertown.

* * *

The American Forest Products Industries, Inc., has announced that there are now 2332 tree farms in the United States, having a total acreage of 20,499,007. The largest acreages are in Arkansas (3,009,843), Texas (2,741,825), Washington (2,541,550), and Alabama (2,253,263).

* * *

Paper production in India in 1949 was 105,408 long tons, an 8 per cent increase over 1948.

* * *

Procurement authorizations for France for pulp, paper, and paper products by the Economic Cooperation Administration will amount to $149,000. The contract period for American suppliers ends on July 31, 1950, and terminal delivery date on Jan. 31, 1951. A similar authorization for the Federal Republic of Germany amounts to $200,000. $298,211 for wood pulp (sulphite and sulphate) has been made for Korea.

* * *

Celdecor Africa (Pty.) Ltd., Benoni, Union of South Africa will design and erect an integrated pulp and paper mill in São Paulo, Brazil, for Refinadora Paulista, to produce 5000 tons per year of fine writing and printing papers from bagasse. The mill will include an electrolytic plant to make chlorine and caustic soda. The mill will follow the all continuous lines applied in the recently started mill in Algeria, North Africa, for the production of papers from esparto grass. Production will start early in 1952.

A 30-ton per day Celdecor continuous unit for producing corrugating paper and liner board from rice straw has been ordered by Fabrica de Papel, "N. S. Aparecida" S.A., São Paulo, Brazil.

* * *

The 7th edition of "Principles and Practice of Flow Meter Engineering," by L. K. Spink is now available and may be obtained from the Foxboro Co., Foxboro, Mass.

* * *

Bauer Bros. Co., 1715 Sheridan Ave., Springfield, Ohio has just issued its Pulp Refiner Bulletin P-1.

* * *

A bulletin "How to Sell to the United States Army" may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. at 30 cents per copy.

* * *

The 4th National Conference of the American Society for Quality Control will be held at the Milwaukee Auditorium, Milwaukee, Wis., on June 1–2, 1950. A program can be obtained by addressing the Society at Box 1204, Milwaukee 1, Wis.

OBITUARY

Killey E. Terry

Killey E. Terry, Chief Engineer, S. D. Warren Co., Cumberland Mills, Me., died in Portland, Me., after a two-months illness on April 1st. Mr. Terry was born in New Bedford, Mass., on May 2, 1883 and graduated from the Massachusetts Institute of Technology as a mechanical engineer in 1906. He was a member of the Technical Association and in 1934–1935 was President of the Am. Pulp and Paper Mill Superintendents Association.

Wilbur F. Pray

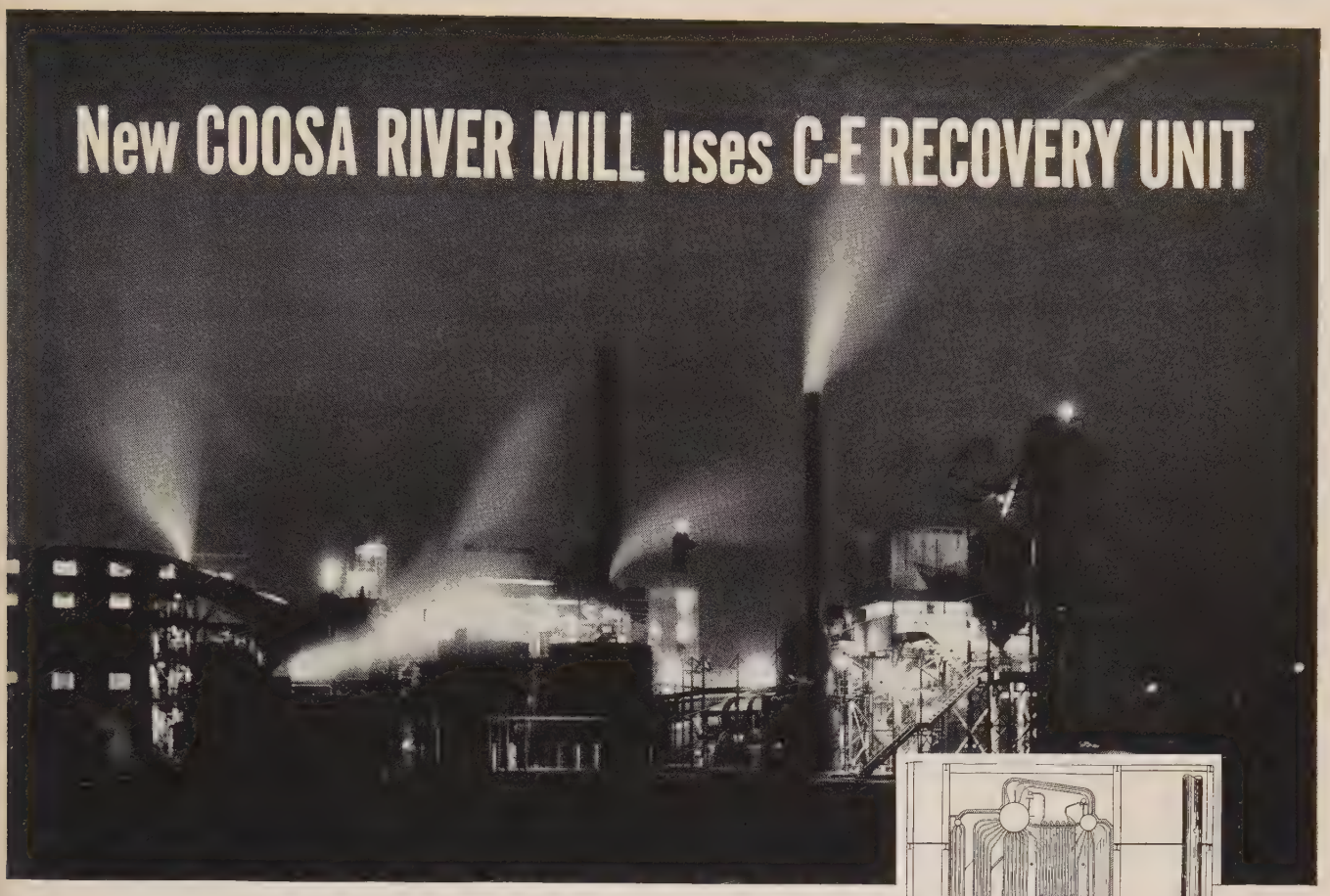
Wilbur F. Pray, Eastern District Manager for The Askania Regulator Company, died in Boston, Mass., Sunday, April 16, following a four-month illness. He was 50 years old. A native of Calais, Maine, and an engineering graduate of the University of Maine in 1922, Mr. Pray spent most of his business life in engineering sales with the Furnace Improvement Co., the Locke Regulator Co., and the Askania Regulator Co. He was widely known for his work in promoting the use of oil hydraulic controls in the paper industry as well as in the power and boiler plant field. He was the author of a number of papers on the control of industrial processes.

Mr. Pray joined The Askania Regulator Company in 1933 as a salesman in the eastern territory. During the war years he was in charge of development at the company's Chicago plant, and after the war he returned to field application work with headquarters in New York.

He lived in Hastings-on-Hudson, N. Y., with his wife, Mary Smith, and daughter, Sally, a student at the University of Maine. Also surviving is his mother, Alice L. Pray, of Stoneham, Mass. Funeral services were held at 2 p.m., Tuesday, April 18, at 138 Main Ave., Gardiner, Maine.

Mr. Pray was a member of the Technical Association of the Pulp and Paper Industry.

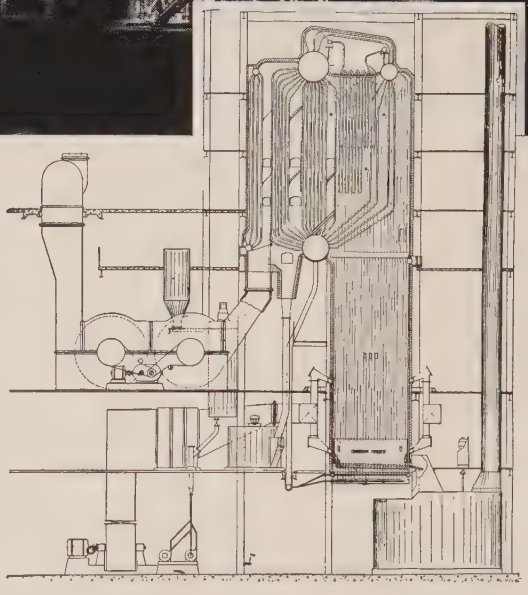
New COOSA RIVER MILL uses C-E RECOVERY UNIT



In the middle of January, three months ahead of schedule, newsprint made from southern pine began rolling out of the $32,000,000 Coosa River Newsprint Company Plant in Alabama. It is the second such plant to be built in the South, and the first in more than a decade. Pine from the river valleys about this area – forty miles southeast of Birmingham – will be used. The mill is expected to turn out 350 tons of newsprint daily, and in addition will produce more than 146 tons a day of dried fully bleached kraft pulp for the facial tissue and creped wadding plants of the Kimberly-Clark Corporation.

The mill is equipped with a C-E Recovery Unit (shown at right), designed to burn 750,000 pounds of black liquor solids per 24 hours and will produce steam at 590 psi and 730 F.

The reliability, economy and operating efficiency of the C-E Recovery Unit have been service-proved in pulp mills all over the country. The choice of a C-E Unit by Coosa River Newsprint Company is just another example of the wide acceptance of Combustion Engineering—Superheater equipment in this field.



Sectional elevation of C-E Recovery Unit

B-390

COMBUSTION ENGINEERING–SUPERHEATER, INC.

200 Madison Avenue • New York 16, N. Y.

PRODUCTS FOR THE PAPER INDUSTRY INCLUDE RECOVERY UNITS, STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; ALSO PRESSURE VESSELS

LOCAL SECTION ACTIVITIES

Reports of Meetings, Personnel and Events

New England

The Lowell Textile Institute's plans for its new Paper Engineering program were presented on Friday, March 24, to members of the New England Section at a meeting held at the Hotel Sheraton in Worcester, Mass.

Details of the program were announced by John J. Desmond, Jr., Commissioner of the Massachusetts Department of Education and Kenneth R. Fox, President of the Institute.

President Fox, in outlining the events connected with the inception and final completion of the plans for the Paper Engineering course, as well as for the Institute's new Leather Engineering curriculum, pointed out that textile, paper and leather production, and processing played a vital part in furnishing tax income and wide employment to the Commonwealth. He stated that by meeting the educational needs of these three phases of industry, Lowell Textile can serve the state more effectively as well as render a beneficial broadening of the school's educational scope by means of the added Paper and Leather Engineering facilities.

It was announced that the Legislature had approved a grant of $750,000 to build and equip a Paper and Leather building at the Institute and that the final plans are now before the State Building Commission. Construction is expected to begin in May with completion in time for full use of the building's facilities in September, 1951.

A detailed description of the Paper and Leather building was presented by Geoffrey Broughton, Head of the Paper Engineering Department, who said the first floor will measure approximately 12,000 square feet in area and will be utilized for laboratories and Department offices. Provision has been made for two large unit operations laboratories, and microscopy and analytical laboratories specially equipped for the study of problems peculiar to the pulp and paper industry. The second floor will contain lecture and class rooms.

Dr. Broughton stated that two rooms will be equipped for studies of the processes encountered in the converting trade and discussed tentative plans for the eventual installation of an experimental coater together with super-calendering and embossing equipment.

For physical testing, two rooms will contain relative humidity and temperature controls in order to make possible the investigation of paper behavior under varied conditions of humidity. Small scale heating equipment and hand sheet machines will occupy one of the rooms while a number of smaller rooms will be used for staff offices and research.

In announcing the formation of an Industrial Advisory Committee headed by Courtney H. Reeves of the Carter Rice Company, Dr. Broughton expressed the hope that those in the pulp and paper industry would act as advisers concerning the Paper Engineering curriculum and the services which the Institute might perform for the paper trade and industry. He expressed appreciation to a number of the members for their cooperation in studying the equipment lists for the new course and requested the continuing assistance of the pulp and paper industry as a unit.

In discussing the Paper Engineering curriculum, Dr. Broughton stated that the objective would be to train students as engineers rather than as technicians so that a graduate with a B.S. degree would enter the industry as a well-rounded personality with a proper knowledge of the chemical engineering and general engineering fundamentals necessary in the paper making and paper converting fields. To attain this aim the provisional curriculum, copies of which were distributed at the meeting, emphasizes chemistry, unit operations and engineering.

The new department, Dr. Broughton concluded, should also serve as a focus for evening school studies and special courses and already some demand for the last has developed.

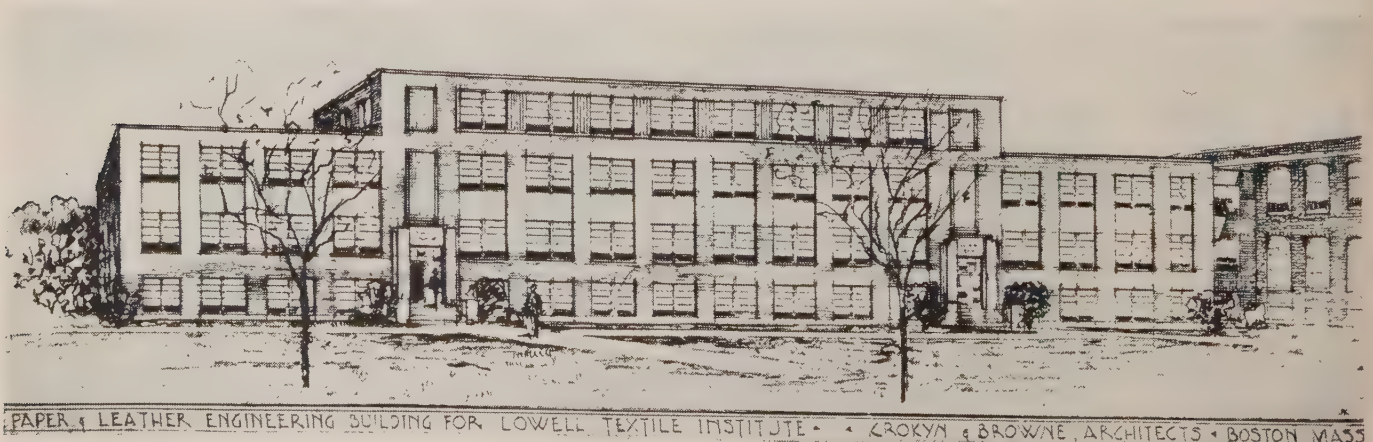
A two weeks' study in Paper: Its Properties and Uses is planned for this summer. This intensive course will be sponsored by the Boston Paper Trade Association. By activities such as these, together with the regular four year Paper Engineering program, a beneficial educational service can be evolved. Its success will be measured by the cooperation of the industry.

At an informal discussion following the meeting, members present expressed great interest in the new Paper Engineering Department.

A. G. Dreis, *Secretary*

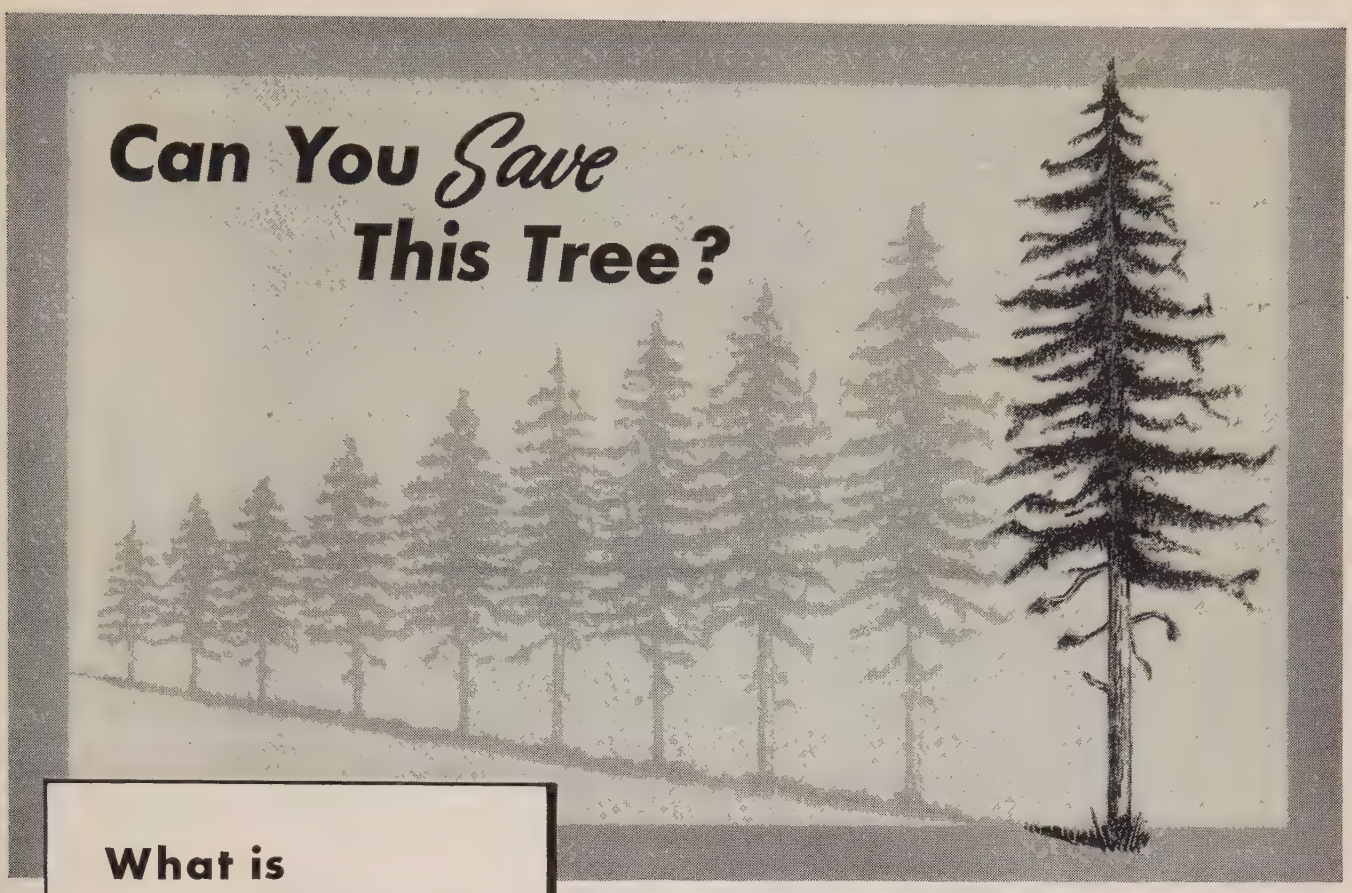
Delaware Valley

The March 23, 1950 meeting of the Delaware Valley Section was held at the Engineer's Club, Philadelphia. Chairman John P. Weidner, Container Corporation of America, announced the appointment of a nomination committee composed of the following: Joseph Paciello, E. I. Du Pont de



PAPER & LEATHER ENGINEERING BUILDING FOR LOWELL TEXTILE INSTITUTE • • CROKYN & BROWNE, ARCHITECTS • BOSTON MASS

Can You *Save* This Tree?



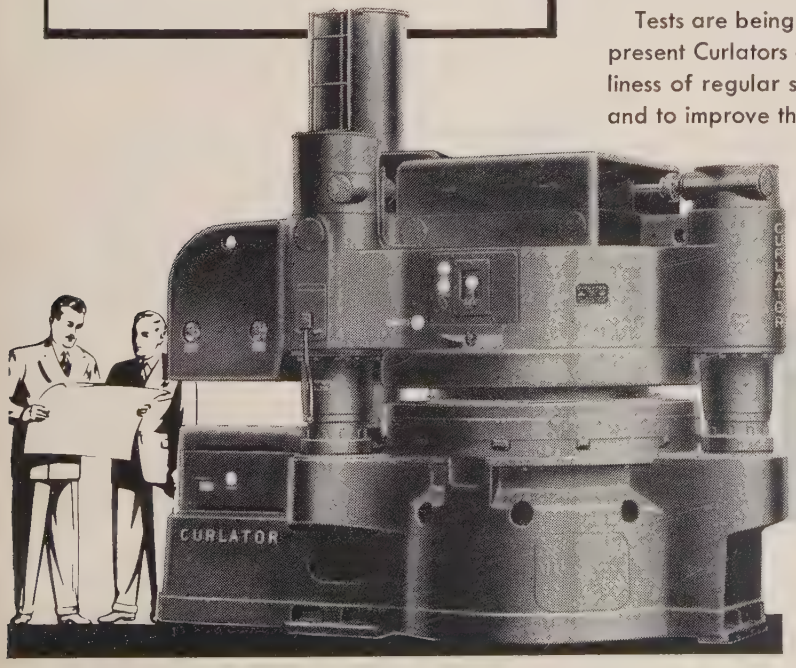
What is CURLATION?

CURLATION is a new mechanical process for improving pulp properties, fully tested and thoroughly proved. Curlation not only produces a permanent change in the shape of pulp fibres, but also exerts a powerful de-shiving action, with negligible change in freeness.

CURLATION MAY BE ABLE TO *Save* 10% OF YOUR WOOD

Yes, Curlation may be able to save 10% of your wood, if you operate an unbleached sulphite mill. Curlators now in commercial operation on newsprint sulphite are making possible the manufacture of sulphite pulp of equal quality to that previously produced, with a saving of 10% in wood plus substantial savings in coal, limestone and sulphur. You, too, may be able to cut costs with Curlation. Why not investigate?

Tests are being conducted on new applications of Curlation. At present Curlators are being used effectively to improve the cleanliness of regular sulphite, to increase the yield of news sulphite, and to improve the bending qualities of folding boxboard liner.



WRITE for new bulletin C-2 on the C-50 CURLATOR. Inquiries are invited.

CURLATOR†
Corporation
565 BLOSSOM ROAD · ROCHESTER 10, NEW YORK

†T. M. Reg.—Curlator Corporation, Rochester, N. Y.

Nemours and Co., C. M. Connor, W. C. Hamilton and Sons, and George D. Fronmuller, Scott Paper Co.

August S. Erspamer, P. H. Glatfelter Co., Chairman of the Program Committee, called attention to the April and May Meeting programs.

On April 27, K. P. Geohegan, Aetna Paper Co. Division, The Howard Paper Mills, Inc., Vice-President of TAPPI, will talk on and lead discussions on the subject, "Pulp Testing." On May 25, a panel discussion on the subject, "Engineering" will be held.

Chairman Weidner welcomed F. D. "Ben" Long, Container Corporation of America, Past Chairman of the Chicago Section and George H. Cash, J. O. Ross Engineering Corp.

Drying of Paper

Arthur J. Haug, Scott Paper Co., introduced the speaker of the evening, A. E. Montgomery, Vice-President of the J. O. Ross Engineering Corp., a TAPPI member since 1923, former chairman of the Drying and Ventilating Committee, now a member of this committee. After Mr. Montgomery's talk on "The Drying of Paper" and the spirited discussion which followed, appreciation on behalf of the Section to Mr. Montgomery was expressed by Mr. Haug and the meeting adjourned. The attendance was about 70.

Mr. Montgomery's remarks follow:

"It is always amazing how little understanding concerning how paper is made is possessed by intelligent, educated people who have had no contact with papermaking, but it seems to me equally amazing how we, who live with papermaking, tend to follow old practices, condoning old faults, but seldom having the temerity to strike out on an entirely new trail.

"Drying of paper on the paper machine is not modern, scientific drying. We want strength, but what do we do? Many years ago, John Alexander at Port Edwards developed an electric drier. Two machines, side by side, and similar in all respects up to the drying section were run with identical furnishes, etc. One machine had a conventional drier section, the other had an experimental drying unit made up of conveyor belts and electric driers. The paper dried under the electric energy had twice the Mullen strength of that made on the other machine. The strength had been taken out of the paper in the conventional drier section where the paper was dried under tension. Grainy edges are always a problem and usually discussed when talking about drying paper. The causes of grainy edges relate to tension of the web in the conventional driers.

"We want economy of operation. Every truly modern drier is enclosed in an insulated chamber. All paper machines with one exception, so far as I know, are open. Even the drier heads are open and uninsulated. A drier section with fifty 60-inch driers will radiate heat through the ends of the driers equivalent to 1,400,000 B.t.u./hr. With steam cost at 50 cents per million B.t.u.'s, this is equivalent to $100 per week or $5200 per year. The question of insulation brings up the possibility that the edge of the sheet may become too hot. It can be demonstrated that this is hardly likely. The heat lost into the room is objectionable. Why is nothing done about it?

"Air is a most expensive papermaking material but how much consideration is given to this expense. Ventilation is only a convenient way to name the process of taking moisture and heat out of the machine room, and thus is essentially a part of the drying problem. Suppose that in a mill making 100 tons per 24 hours we assume that 2.0 pounds of water are removed in the drier section for each pound of paper taken off at the dry end, as would be the case if the paper enters the driers with 31 1/2% dryness and leaves with 5% moisture. The air entering requirement will be about 112,000 cubic feet per minute, or 4.15 tons of dry air per minute, or 6000 tons of dry air per 24 hours and this is a conservative figure. The air cost using outside air at 32° and increasing it to 112°, an increase of 80°, will require about 1.2 pounds of steam per pound of paper. This is 1/3 of all the steam normally used in the machine room. At 75 cents per thousand pounds, the cost will be $180 per day or $4500 per month. An air salesman peddling 150,000 tons of hot air per month at this price would probably make his sales without question for two or three months. Management would inevitably enquire as to ways to cut such an expenditure. Savings of plus or minus $1500 per month are possible on this item. With average outside temperatures of 70° as experienced in the South, the cost is reduced about 44% to $2500 per month. In Canada with minus 20° temperatures the cost would increase to $7200 per month.

"We in America are not very conscious of wastes but want production. Drying rates are quite often below standard and studies may lead to increased drying capacity with resultant production increases. TAPPI has published drying rate reports for many types of paper. Those for paperboard and kraft paper and kraft board have been published twice. The Drying and Ventilating Committee is preparing curves for inclusion in TAPPI Data Sheets. There is also a Standard Drying Rate Code in TAPPI Standards. (Slides were shown of typical drying rate curves for Kraft Paper and Board). It was found that averages for the better machines showed twice the drying capacity as compared to the averages of the poorer machines studied with temperatures and steam pressures the same.

"Why is there such a variation in drying rates? Thinking of it as a problem in heat transfer, any improvement in rate of heat flow from steam inside the dryers to paper on the outside will improve the drying rate.

Q (heat transfer) = U (heat transfer coefficient) × A (area) × ΔT (difference in temperature of inside of drier and surface of the paper on the drier)

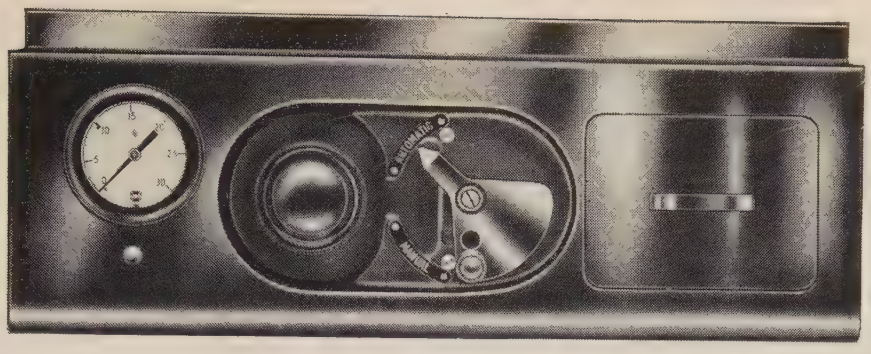
The conductance coefficient U can be calculated if the surface coefficients, the metal in the wall, etc. are known. Variables might be mentioned which if known may lead to solutions of problems resulting in operating on the upper portions of the drying rate curve.

"From steam to solid drier metal heat transfer may be influenced by scale on the interior surface. Whether the condition of the surface tends to cause drop-wise of film condensation may cause large differences. The drop-wise condensate may be caused by chemicals or oil in the steam. Steam velocity is a factor, certain parts may become hotter than others. Another factor is turbulence of steam. Lack of turbulence in condensed water may cause ringing resulting in very much lowered heat flow. Another factor is that of noncondensible vapors on drier shell interior. Another is superheat.

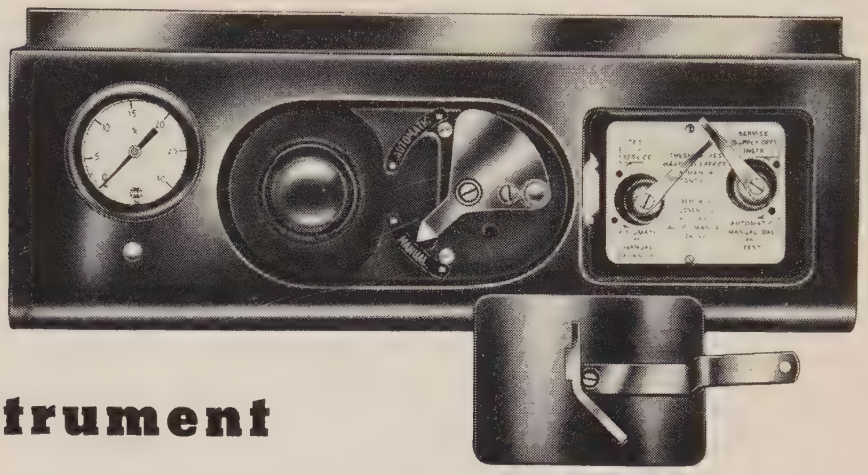
"Scale up to 1/4-inch has been found in driers and will certainly hinder heat flow. Generally, this is not a serious fault. The metal wall thickness is not of dominant importance for low drying rates. For example, a paper machine having a poor rate of heat transfer using a 1-inch cast-iron wall as 100% the rate will be increased to only 103% if the wall thickness is reduced to 1/2 inch; or decreased only to 90% if the thickness if increased to 3 inches. However, for good drying rates the change from 1 inch to 1/2 inch will be on the order of 100% to 109% and from 1 to 2 inches, 100 to 74%, respectively.

"On a Yankee machine where the conductance coefficient is high, the conductance becomes dominantly important. Where it is possible to approach a heat conductance of copper in the metal used, there is a very marked improvement. In the Technical Association Papers of 1946, I have given figures for metal walls.

"The most important step in effect on drying rate is that of heat transfer from the metal wall to the paper itself. The factors entering here are almost always greater in effect than all the others together. The condition of drier surface



No other control instrument



has an external manual-automatic station as mistake-proof as this

***EXCLUSIVE** mechanical interlock prevents switching into wrong position*

***EXCLUSIVE** "balancing" arrangement prevents "bumping" on changeover*

Among the many features which have put the Bristol Series 500 Air-Operated Controller way out front is the unique External Manual-Automatic Station.

1. "Test" and "Service" positions are mechanically interlocked. Operator cannot, by mistake, go *through* "Manual" position into either "Test" or "Service."

2. Output pressures of the controller and the regulator on panel are measured by the *same* gauge. This enables operator to achieve exact *balance* before going from automatic to manual control or vice versa, thus eliminating the possibility of a "bump" to the process during changeover.

Bristol's External Manual-Automatic Station is an integral part of the controller installation . . . yet can be used independently for manually controlling the process *before* the controller is installed or *after* it has been removed for any reason.

Read what else Bristol Series 500 Controller gives you . . . calibrated control, single service adjustment, reset stops, etc. Write for new Bulletin A120 on Series 500 Air-Operated Controllers, THE BRISTOL COMPANY, 102 Bristol Road, Waterbury 20, Conn.

BRISTOL

Engineers process control for better products and profits

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

is very important. We know the value of doctors in improving the surface and also realize that more and better doctors improve drying. It would seem that someone of an inventive mind might develop a drier cleaner such as a burnishing device which would be more effective than most doctors currently used.

"The nature of the paper surface is important. Its ability to make effective contact with drier metal wall is a big factor. Certain weights dry better than others. The reason might well be the nature of the surface. The surface of the paper is more important than the ability of the fiber to give up its water. This factor is very marked on Yankee driers.

"The paper moisture content entering and leaving the drier section is a factor. A study made by TAPPI showed that there is a tendency to over-dry papers. One example found the moisture of the paper to be 5% with 37% of the drier section left for the sheet to travel over.

"Tightness of draws is a factor. One case was known where the drying rate was increased 15% merely by tightening draws; incidentally, physical tests came down. In a Southern mill, a large kraft machine had wet streaks running across the web. The intermittent blackening and drying effect was traced to a chain drive where a slight change in pitch caused a barely perceptible slackening, but which resulted in several per cent moisture differences in the machine direction.

"The tightness of drier felts have an effect. On those machines having high drying rates the felts usually are taut. A big improvement was demonstrated on a machine making carton stock which had top and bottom drier felts on the first half of the drier section. When these were tightened, the increase in drying rate was amazing.

"The speed of the machine is a factor. On the average, short machines running at lower speeds have higher drying rates than long ones. More air is pulled into the space between the paper and driers at higher speeds. A machine used for humidifying paper had 10-inch diameter idler rolls with 180° contact. With paper run taut at 800 f.p.m., this roll could be held stationary with no apparent effect on the traveling web. The sheet slipped around this roll as though it were greased due to the slippage on the cushion of air.

"Diameters of driers is another factor. Small diameter driers give the highest drying rates. It is probable that this results from the greater unit area contact and greater wrap pressure.

"Vapor absorption systems, as often used on board machines or Ross-Grewin systems as used on paper machines, have some effect. This can be explained by the increase in temperature difference (ΔT, in the equation) due to the lower drying temperature caused by the air.

"What don't we know about drying? We don't know how the water leaves the sheet. How much goes through the drier felt and how much goes into the air? If all evaporation took place on the paper surface, there would be an impossible temperature drop. Some probably goes through felt as water and some as vapor according to conditions. This would be a good field for some investigation. Perhaps, more felt driers would help in some cases. It has been suspected that felts at the dry end have been dried through the sheet at times.

"We might have some discussion of the value of felts on board and pulp-drying machines, also on air-drying systems."

Discussion of Mr. Montgomery's Remarks

H. J. LeBeck, Jos. T. Ryerson and Sons: Concerning the cleaning of drier surfaces, Ryertex is sold for use as doctor blades but I do not feel that this is a proper application. The causes for drier accumulations should be taken care of further back, that is, in the stock preparation in the beater room. What causes scale and fuzz?

Mr. Montgomery: It does not take much fuzz to lower drying capacity. What kind of a paper machine were you thinking about?

Mr. LeBeck: In the case of a Yankee drier, the surface is crowned and, therefore, doctoring is not practical. The surface is cleaned chemically.

Mr. Montgomery: One of your members mentioned to me that he thought there was a possibility that they were having fuzz due to causes resulting from closing the system.

C. M. Connor, W. D. Hamilton and Sons: What effect does drier temperature have on fuzz?

Mr. Montgomery: If the drying temperature is excessively high at the wet end, it will tend to cause fuzz.

Mr. Connor: I had thought that too, but I am not so sure, now.

I. J. Gruntfest, Rohm and Haas Co.: I am interested in the reasons for the Yankee drier on a machine-glazed sheet having five times the drying rate that of a nest drier machine.

Mr. Montgomery: It is the glazed surface contact on the smooth drier surface.

Mr. Gruntfest: There is no breaking of surface contact.

Mr. Montgomery: It should be possible to design a small pressure roll to cause better contact of the sheet to drier surface. Maybe two times the drying rate efficiency would result.

J. C. Harper, Jr., Downingtown Mfg. Co.: These are used in Europe and they generally have less driers on wet end drier sections than in this country.

Mr. Montgomery: I recall being called in on a pulp drier installation. An air system was being considered to increase the drying rate. I explored the steam input and drainage rates and from the results suggested that drier felts be used and also rider rolls similar to those used on board machines to prevent sheet slackening at the dry end when a calender break occurs. I returned eight months later and found that the rider rolls had been installed. With the same steam pressure and the same moisture contents in and out I found that there had been an increase in the drying rate of over 100%. Their practice was to clean the driers every week with a lathe-like attachment using emery cloth. The resulting pulp drying increase was due to cleanliness of drying surface and better contact.

John P. Weidner, Container Corporation of America: You mentioned getting a five fold increase of drying with a Yankee drier. How much might be possible with felts as against drying without felts?

Mr. Montgomery: Drier felts are used on paper machines on account of lack of strength in the sheet to run without felts. In the South, kraft boards are dried with various arrangements, 9 to 16 point board. It is the general consensus that full drier felts give the highest rate of drying.

Mr. Weidner: How much increase?

Mr. Montgomery: I do not know. It depends on many factors but is much used for lighter cartons. It is a question of merit in the specific installation.

Mr. LeBeck: Does the microporosity of a surface have any effect?

Mr. Montgomery: Not known to me. Most of my experience has been with cast iron.

Mr. LeBeck: I would think that some porosity of surface would be needed for its effect on the contact.

Mr. Montgomery: I believe that the more highly polished the surface, the better.

Samuel M. Bratton, Pusey and Jones Corp.: In the case of newsprint machines, why leave the first driers bare?

Mr. Montgomery: I don't know. Why are desuperheaters used? Do they work?

Mr. Connor: There is a variable effect. In some cases there is an appreciable change from their use.

Mr. Montgomery: There is still some question as to their need.

Mr. Connor: It depends on conditions, if faulty, may help.

Mr. Weidner: Desuperheater works on indirect heating.

Mr. Montgomery: Dr. Macadams in his text on "Heat Transfer" says they give slight or no advantage. They do make control more difficult.

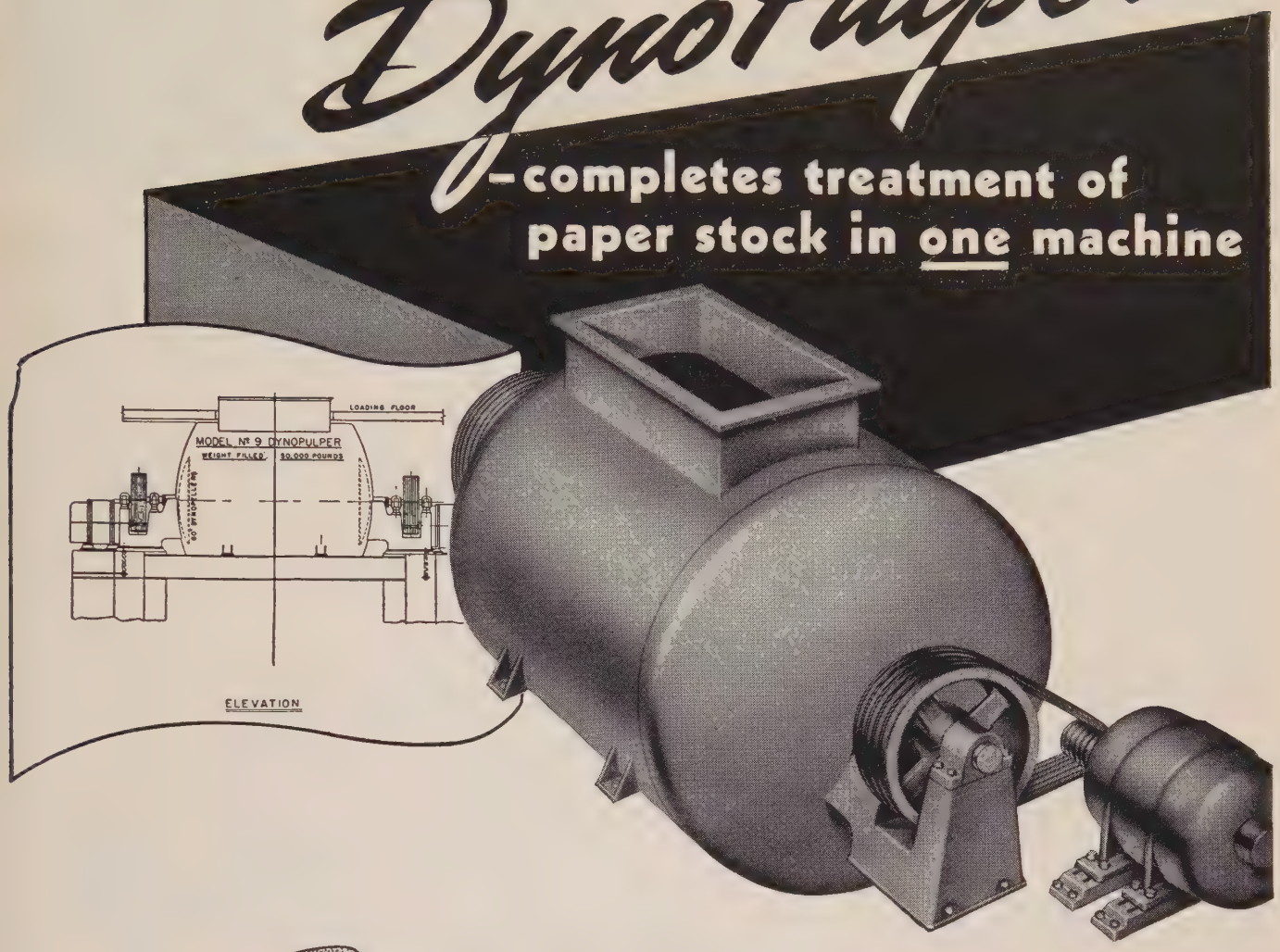
Mr. Connor: I do not know the theory. The B.t.u.'s are in the steam and should be available. It is a question of what goes on. Superheat in supercalender steam is not so good.

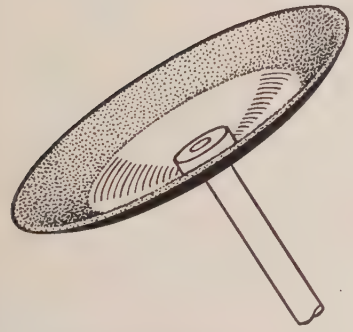
Charles E. Hill, Pusey and Jones Corp.: What is the optimum ΔT.

Mr. Montgomery: On a board machine using a vapor absorption system or a paper machine using a Ross-Grewin system, a 10% increase in drying rate was found. The problem is more complex on a paper machine as compared with a coating paper drier where the coating is all air-dried. Air in the machine system lowers the temperature of the sheet just as clothes hung out to dry in air have their temperature lowered by evaporation. The question as to what should the air supplied temperature be? The temperature need not be very high as was shown at Longview Fibre where they used oil-fired air to get high temperatures as high as 700°F. 195°F. was found to be a practical maximum. For board, the ideal from an economy standpoint would be to supply air at the same temperature as the board. If lower, the board heats the air. If higher, there is only a small heat transfer

Here's the new DynoPulper

—completes treatment of paper stock in one machine





The DynoPeller

is the heart of all DynoMachines. Its concave face is lined with rough, hard carbide particles. As the DynoPeller rotates it causes a suction at its center that pulls the stock towards it. Centrifugal force then causes the stock to flow rapidly over the rough carbide particles. This effective dynomizing action completely disintegrates the stock . . . separating each fibre from its neighbor while maintaining its original length.

The DynoPulper

is a highly efficient machine for disintegrating pulp, waste paper or any type of stock. The stock is charged all at one time into the top of the horizontal circular vat. It is vigorously dynomized by two opposing DynoPellers—as described at the left. The fibres are quickly and completely separated . . . at surprisingly low cost.

The DynoPulper is used for either batch or continuous operation. Also available in laboratory sizes. Write for additional information.

RPR-3

RICE BARTON Research Corporation

WORCESTER 1, MASS.

from air to sheet at best. The air takes off surface moisture only. I knew an example where a machine making asbestos for saturating felt was using starch for an adhesive. With air on the surface strength tests were down. They air cooled the sheet so that the starch didn't get hot enough to cook.

MR. CONNOR: What is the effect of a decrease in drier diameter with the same surface area?

MR. MONTGOMERY: There is an increase, probably due to increase in unit pressure between sheet and drier surface. Also, there is a more abrupt angle of contact between sheet and drier.

AUGUST S. ERSPAMER, P. H. Glatfelter Co.: What about the power to drive the driers?

MR. MONTGOMERY: There is little difference.

JAMES M. FARNUM, Taylor Fibre Co.: What about the amount of air drawn in at different speeds?

MR. MONTGOMERY: The short machine will give the better drying rate. This is from standpoint of drying rate alone.

R. T. DEPAN, Downingtown Mfg. Co.: Are air blowers an advantage at high speeds?

MR. MONTGOMERY: Yes.

QUESTION: What can be done about grainy edges?

MR. MONTGOMERY: Grainy edges are due to the different tensions exerted in pulling the sheet. In drying latex sheets the edges shrink in to marked degree giving an hour-glass appearance. In cases where the sheet is slit at the wet end, grainy edges are found on the edges in the middle of the machine as well as on outer edges. What can we do about it? We can work on all the factors having to do with shrinkage back to the pulp used.

MR. DEPAN: Would vacuum through the sheet aid in drying?

MR. MONTGOMERY: It will not work. The amount of air necessary precludes its use. Can't even be used on air pockets. Pulling air through felts has been done successfully in Germany where they use woolen drier felts with high porosity. We asked why not reverse the process and blow air through? Cotton or asbestos felts which we use, customarily, do not have enough porosity.

KINGDON R. WATT, Franklin Mills, Inc.: Referring to your diagram and the vapor coming off, would air help dissipate the vapor film on lightweight tissues?

MR. MONTGOMERY: Yes, the Grewin system works on lightweights.

MR. CONNOR: Should drier felts be dry at all times?

MR. MONTGOMERY: Yes, wet felts slow drying rates.

MR. HILL: What is the effect of humidity of air used?

MR. MONTGOMERY: Using air from machine room or outside and heat to 180° and there is virtually no difference. The advantage in taking it from outside is that it helps to balance the ventilation in the mill. If the humidity is very high in the machine room, however, there will be a very material effect.

FRANK J. LOVEGREN, *Secretary*

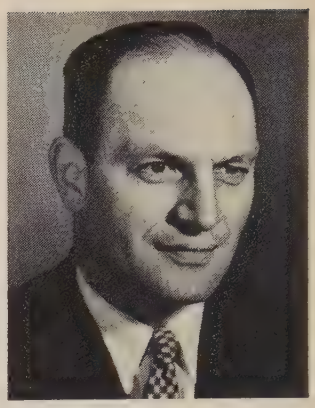
Lake Erie

If all goes well, the Cleveland, Ohio area will soon have a local section of TAPPI. About a year ago four members of TAPPI began to make preparations for the birth of a group which was named the Lake Erie Papermaker's and Converter's Association. The early efforts of Bill Manor, Consolidated Paper Co., Pete Spring, Chase Bag Co., Bill Schoenberg, Lord and Schoenberg, and Lew Burnett, Ohio Boxboard Co., were rewarded by an attendance of about 150 men of the paper and converting industries at the first meeting. R. G. Macdonald, Secretary of TAPPI, participated in the first meeting at which Lew Burnett of Ohio Boxboard was elected chairman of the group. Other officers elected were Bill Manor of Consolidated Paper, Vice-Chairman, and Bill Schoenberg of Lord and Schoenberg, Secretary-Treasurer.

Art Cheely, left, discusses the program with LEPCA officers, Bill Schoenberg and Bill Manor

The executive committee includes Arthur Cheely of Hankins Container Corp., William Hasselo of Container Corporation of America, Mel Kernan of Ohio Boxboard Co., Earl Knapp of Auglaize Box Board Co., Karl Krancher of Ball Bros., and Arthur Goetz of River Raisin Paper Co.

S. A. Stephens



Lewis K. Burnett

Meetings have been held monthly since that time. They are scheduled for the third Friday of every month and are held at the Hickory Grill, 929 Chester Ave., Cleveland. There is a social hour from 6 to 7, dinner at 7:15, and the meetings open at 8:15.

The program committee has been very successful in scheduling meetings of interest to both papermakers and converters. Earlier meetings have included talks on: Paper and Paperboard Finishes, Sizing, Color Control, Electrical Control, Safety, Petroleum, and Labor Relations. S. A. Stephens, International Second Vice-President of the International Brotherhood of Pulp, Sulphite, and Paper Mill Workers addressed the group on February 17. The following is a digest of his remarks at that meeting:

Labor Management Relations, Past, Present, and Future

"Labor unions started in our industry because we did not understand each others' wants. When I worked eleven and thirteen hours for less than a dollar a day, and my job was held at the whim of my supervisor, we did not understand each other.

"First, we had to realize that there was a place for both of us; we had to learn how to sit down at the conference table. Fortunately we have learned. I am proud of the record of our union and of its relations with management.

"However, there is no complete solution. We must work with the employees that you, the employer hire. Sometimes we wish that we did not have certain persons in our union. I am sure that management, at times, wishes that certain individuals on their side of the table were elsewhere. Yes, we have, and will continue to have problems to solve.

"Our mutual interests should always keep us working together to overcome these problems. Let us look at some of the union activities which are inspired by these mutual interests, and which benefit management. You will see that we do more than negotiate contracts.

"We are determined to wipe Communists out of our ranks. We can count on your help. Again let me remind you that we must accept those you hire. A good job of employment on your part makes our work easier.

"We promote fire protection in the woods. Through our backing, legislative action which protects the raw material on which we all depend has, and will be taken.

"We promote protection from unfair foreign competition. Our officers keep track of the various agreements and treaties which affect. Recently, we had a representative in Washington advising our government as to the effect on labor of certain foreign committments.

"You say we are selfish in these matters? Yes, we are. But our selfishness is protection and help for our employers. Our mutual interests make it impossible to be otherwise.

"We concern ourselves with Canadian-United States news print relationship. You might say—"How does that help us?" A little investigation would show that 85% of the

7 REASONS

why you will find Alpha* Protein makes a superior adhesive for coating paper...

1. Alpha* Protein solution is stable over a wide temperature range.
2. Alpha* Protein is compatible with the various pigments used and binds them to the fiber of the raw stock easily.
3. Alpha* Protein adhesive has a color which does not affect, to any extent, the colors of the pigments used or their hiding power.
4. Alpha* Protein alkaline-cut adhesive permits addition of formaldehyde to coating colors to make the finished paper water resistant.
5. Alpha* Protein adhesive is free-flowing at a low water ratio. It is clean.
6. Alpha* Protein adhesive keeps pigments or other insolubles more uniformly suspended—prevents formation of hard, difficult-to-disperse masses.
7. Alpha* Protein adhesive sets quite rapidly and dries easily without undue shrinkage or interference with the finish when the paper is calendered.

*Trade Mark Registered

FREE! Concise yet complete, profusely illustrated . . . this valuable new book on Industrial Soya Proteins gives you complete details of the advantages of Alpha* Protein in coating paper. Also has chapters on the use of Alpha* Protein in the Glidden Prosize Process for paper sizing and on the use of Glidden Prosein* in adhesives and binders. Write for this book today!

The Glidden Company
SOYA PRODUCTS DIVISION
5165 West Moffat Street
Chicago 39, Illinois

QUALITY Glidden PRODUCTS

Canadian newsprint industry is owned by U. S. capital. Yes, our concern is tied in with your interests.

"Sometimes we have common problems that are solved best through cooperation. One of them is the constant mechanization that has taken place and is taking place in our industry.

"Whenever a labor-saving machine is installed, a new problem arises. Remember please, that the immediate effect is to eliminate jobs. Human beings hold these jobs. Any of you who have watched your jobs disappear or be taken from you, will agree that a little counseling and a little patience are needed at such times. As an organization, we appreciate the need for new machines and productive efficiency. As an organization of human beings we insist that you act with due regard for human feeling and emotions.

"Our objectives for the future can be stated rather simply:

First, we want to organize the industry. We want to sit down at the table with management as a recognized and accepted agent of the employees. This must come first. It has in the past and will in the future.

Second, we wish to progress with the times. Twenty-five years ago, I sat down to negotiate, in Canada, a company paid pension system. Retired workers are now enjoying pensions of $100 and more as a result of that bargaining. We expect to continue our efforts toward progressive, practical benefits.

Third, we wish to keep out undesirables. We are proud of our union and the people in it. We are patriotic citizens and we will eliminate Communists or any other people that do not have allegiance to their governments.

"We think that these steps will help you. We ask that you believe us and will treat us as if they will help both the union, and the company concerned. Thank you for your attention."

What's New in Adhesives?

Lew Burnett of Ohio Boxboard, Chairman of the Lake Erie Papermaker's and Converter's Association, announced the appointment of the following nominating committee at the March 17 meeting of the association: A. W. Cheely of Hankins Container Corp., A. Kjellstrand of Buckeye Ribbon and Carbon Co., and P. H. MacDowell of the A. L. Garber Co.

Three representatives of the adhesive industry gave their answers to the question "What's New in Adhesives?" M. E. Stern of Federal Adhesives discussed adhesives for envelopes, setup, and folding boxes, He considered the recently publicized self-sealing, flavored, and moisture resistant rums for the envelope field. He described the importance of the mechanical advances in machinery as well as the new resin emulsion adhesives. One of the most important additions to the adhesive line is the group that can be used for all types of window applications without regard to the type of transparent material or board being used. The same adhesive can be used for the various types of cellophane and cellulose acetate films. This advance will greatly simplify the problem of maintaining adhesive inventories for this type of work.

Adhesives for Bags and Tubes

E. S. Gantt of Corn Products Refining Co. discussed adhesives for bags and tubes. His remarks follow:

"In a great majority of cases the adhesive used for either tube winding or bag seams is tailor made. For each use there are a few standard formulations but these are usually the basis for variations determined by individual combinations of materials fabricated and machine speeds, as well as particular requirements of the adhesive film.

"In tube-winding two basic types of corn products are used as adhesives. A slightly converted, low-soluble white dextrine is cooked in a borated paste with approximately two pounds of water for each pound of dextrine, to give a short lardy paste. This paste has fair tack, dries rather slowly and is used where a number of plies of chip board are combined in a heavy tube. Here the plies are often submerged in the adhesive; the time interval is comparatively long between the application of adhesive and winding on the mandril and the actual winding is relatively slow. Paste of this type does not penetrate readily into the board and an excessive amount is to be avoided.

"A more converted brown dextrine is cooked in a borated paste with about one pound of water per pound of dextrine to make a more fluid paste with better tack and much shorter drying time. This type of adhesive is used on 2, 3, or 4 plies of board in most winding operations run at normal speeds. Increased speeds in this type of winding and the addition of decorative outer plies of foil, coated and printed paper, and similar materials has prompted the use of adhesives of higher solids content. A dextrine paste may be prepared with 70% solids by the use of corn sugar and sodium nitrate. Approximately 60% dextrine and 20% each of sodium nitrate and sugar with the addition of 30% water to the above solids will give a suitable paste for this purpose. The dextrine used will vary with the flexibility of paste film required and the sugar and sodium nitrate will vary with the percentage of water that can be tolerated.

"In winding convolute tubes the adhesive requirements are similar to those for spiral tubes with exception of the case where the label is stuck to the tube with the same application of paste that forms the tube. Here the paste must remain wet and tacky long enough for application of the label. This results in inadequate adhesion of the edge of the paper or board forming the tube unless animal glue and dextrine are mixed for this adhesive. Twenty-five to fifty per cent dextrine is ordinarily used with the animal glue in this application.

"In preparing seam pastes the same two basic types of adhesives are used with an even greater variation in the individual application. The low soluble white dextrine made into a lardy paste is used where importance is attached to squeezing the paste into corners and folds. It is the standard paste for bottoming and for the small, heavily coated flour bags. For very lightweight kraft bags this dextrine is often replaced with a starch in an even heavier paste with higher water content. This is an inexpensive adhesive, of course, and it also increases the probability of wrinkled seams.

"The more converted, brown dextrines cooked to a fluid tacky paste are used for the greater proportion of bag seams such as multiwall kraft bags. The use of asphalt and wax as moisture barriers has introduced a problem in this field. The addition of a solvent such as carbon tetrachloride has given the best results in this application. One or two per cent of carbon tetrachloride added to the paste is usually sufficient. Mixing, however, is difficult as the chemical is volatile and the fumes are noxious. If only small amounts of this type of adhesive are required it is preferable to buy a prepared adhesive for this purpose.

"The demand for waterproof seam pastes has increased greatly and has prompted considerable work on both adhesives and resins. Cooking the resin and catalyst in the paste has largely replaced the previous practice of adding a resin to a cooked and cooled paste and then adding a catalyst. Some dextrines definitely give better results than others in the combination with resins. This is true in both the low- and high-converted types and is probably a function of the acid remaining after the conversion and the small amounts of sugars and intermediate products between starch and sugars that remain after the conversion. Thin boiling starches give particularly good results in this application but are usually too viscous and have too much set back in a finished paste. Consequently a formula for this type of adhesive usually contains some thin boiling starch, a converted dextrine for tack, about 10% on dry-weight of a urea formaldehyde resin and 2% of ammonium chloride or 5% salt. It is important that the paste be held at 190° for 15–20 minutes and the pH may be adjusted after cooking to 5.5 or 6.0 with soda

New Camachines are better than ever. If you're in the business of making and selling roll products it will pay you to show your customers the quality points of a smooth, modern *Camachine* roll. Here's what your customers like about rolls that are made on fast, efficient new *Camachines*. They like the uniform density from core to circumference. They like the clean cut edges of the strip. They like the straight smooth sides of the finished rolls. They like the durability of *Camachine* rolls in rough handling and shipping. And they like the smooth way *Camachine* rolls unwind, clean to the core. Start delivering modern *Camachine* rolls now and...

For a line on fast new *Camachines* for paper mill winding send for your free copy of the new bulletin "Mile-a-Minute".

make your customers ask for more

Cameron Machine Company • 61 Poplar Street • Brooklyn 2, N.Y.

Camachine engineers will be pleased to consult with you on any roll production problem.

AA-221

ash to increase pot life or reduced to 5.0 to 5.5 with alum for quicker waterproofing. The ammonium chloride gives quicker waterproofing and the salt gives a more stable paste. This is not a difficult paste to prepare but its storage life is comparatively short. If it is required in relatively small quantities it should be purchased ready cooked. Specialties like cellophane, pyroxalin coated papers, varnished and lacquered papers, and some of the foils are also handled better by prepared pastes unless these are major items of production so as to warrant the preparation of adhesives incorporating solvents or abrasives for use exclusively with these products."

Adhesives for Foils and Films

R. L. Pett of National Starch Products, Inc., covered adhesives for foil, film, and specialty applications. His talk follows:

"The adhesive industry has undergone a great many changes in the past 15 or 20 years and I am sure that you will agree with me that the innovation of synthetic resin adhesives is the most significant. If this subject of resin adhesives was being discussed 15 years ago the subject could be covered most thoroughly in 5 or 10 minutes. However, this field has grown and expanded so that it would be impossible to cover it in the short time allotted me at this meeting. For this reason I will attempt to give you a general outline of the most significant uses and developments in the synthetic resin field to date.

"The use of Starch and Dextrine adhesives proved satisfactory for many, many years in the packaging field. However, as the packaging field grew and began to play a more and more important part in industry we found that these adhesives were not adequate. With the development of cellophane sheeting, plastic films, improved coatings for paper, and high-speed packaging machinery the adhesive industry was forced to look for other types of base raw materials to be used in the formulation of their adhesives. After exploring many fields we finally found that the synthetic resins show the most promise.

"The first synthetic resin adhesives were developed for use by cellophane converters. These were the solvent lacquer adhesives. The cellophane industry quickly adapted them for use in the manufacture of cellophane bags and laminations of cellophane to various surfaces. These lacquers proved quite satisfactory in most respects. However, they were fairly slow drying and the concentration of solvents often caused bleeding of inks. We took this problem under consideration and came up with the resin emulsion type adhesive.

"We have found that emulsions show excellent flexibility of formulation. Generally speaking emulsion adhesives consist of a resinous base material dispersed in water, a plasticizer, and often times a solvent. Simply by changing the ratio of resin and plasticizer these adhesives can be made faster or slower; harder or more flexible. Solvents are added to give penetration into special lacquer coatings on paper, or to penetrate films such as cellulose acetate or cellophane. Emulsions are fast setting because as soon as they come in contact with a surface the emulsion breaks. That is, the water penetrates the surface and the solid resin remains to bond the surfaces together. It is for this reason that we advocate the use of a very thin film of adhesive.

"The most important factor in the rapid use of emulsions is that once the film has dried it cannot be re-emulsified by water. It is this characteristic that gives the adhesive its high degree of water resistance. There are several large folding box manufacturers today who are adopting the use of these emulsions for just this reason. Even though the adhesives are more expensive than starch and dextrine types they feel the added protection from moisture and speed of application will make up for the added cost. Along this same line of reasoning the manufacturer has to be sure that even though the adhesive seems to be holding in his plant it must remain that way for long periods. Starches, dextrines, and animal glues tend to dry out and crystallize, while the Resin emulsions remain flexible and do not soften under high humidites and temperatures.

"With the advent of World War II the packaging field was called upon to perfect better and more protective carriers for war supplies. This called for stronger packages and packages that would withstand submersion in water, the elevated temperatures of the tropics and the sub zero temperatures of the Arctic. Naturally the adhesive industry had to develop the adhesives to seal these packages. We developed adhesives that would withstand water immersion for 6 or 7 days and also protecting coatings for markings on these packages. Most manufacturers were forced to use resin adhesives at this time and when they found how successfully they ran they looked forward to using resins on their regular jobs.

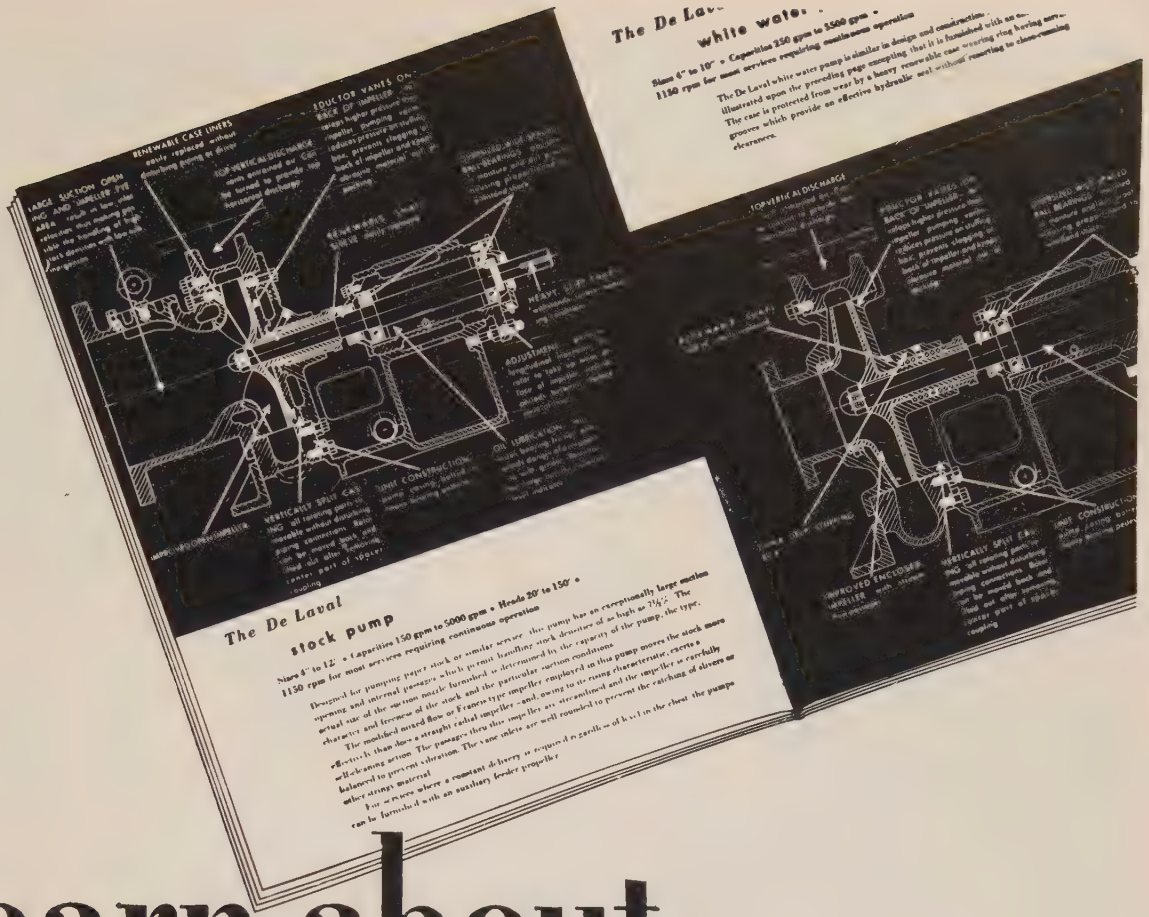
"At the end of the war the packaging industry was quickly converting to peace time operations and were clamoring for more and more synthetic resin adhesives. They found that to meet competition it was necessary to turn out packages that were more versatile and gave the best protection.

"In the fiber can and tube industry for example there was a need for cans and tubes that were more water resistant, tougher, and better moisture vapor barriers. At the present time we have synthetic resins that will not only give this protection, but will increase production. Resin adhesives today will wind tubes at a faster rate than was thought possible several years ago. These synthetic resins may also be used to eliminate barrier materials such as parchment and foil which are now used to great expense to get the desired moisture vapor resistance.

"Along with the lacquer and emulsion adhesives we have developed the hot melt type of adhesive. A hot melt is in a solid state at room temperature and must be heated in order to get it to a fluid consistency. These hot melts contain neither solvent nor water and have 100% solids. Hot melts are well adapted for use as protective coatings and for applications where immediate setting time is necessary. A film of hot melt applied to a surface sets as soon as it hits the air. These hot melts can be made to form hard lustrous finishes or more flexible films.

"Perhaps the newest and most important class of adhesives developed to date are the heat seals. We have developed heat seal adhesives in the three classes of resins mentioned; i.e., emulsions, lacquers, and hot melts. The heat-seal adhesives can also be subdivided into the direct contact and delayed tack type. The direct contact heat seal is coated on a surface and allowed to dry. At a later time this surface is brought into contact with another surface and heat is applied. A band is affected instantly. The delayed tack type is coated and allowed to dry, but it is reactivated with heat and develops a high degree of tack immediately. It holds this tack for some time. The advantage of this delayed tack lies in the fact that the two surfaces do not have to be in contact when heat is applied. A delayed tack adhesive finds use in the bottling industry where the label is heated and then placed on a bottle. The direct contact heat seal type finds uses in fields such as gummed tape, jewelry boxes, and lately in manufacturing milk cartons.

"At the present time most of these heat seal adhesives are of the emulsion type. However, we have developed lacquer types which are particularly adopted for bonding coated surfaces, foil, and cellophane. Along these same lines there are hot melts which are used as heat seals. The hot melt is well adopted for use by manufacturers who coat rolls of paper and then print and cut them into labels. Another large field for hot melts is in the potato chip bag industry. Here the adhesive is applied to the bag in the bag plant and the potato chip manufacturer fills the bag and merely heat seals it to affect a closure.



learn about

the latest improvements in paper mill pumps

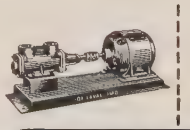
Send for your copy of this new De Laval pulp and paper mill pump catalog and get all the facts about the new line of De Laval pumps especially designed for handling paper stock, white water, liquors, clays and fillers.

As a practical, paper mill man you'll appreciate the many exceptional features of these new pumps.

For example:

- The stock pumps are designed for handling extremely high densities.
- Renewable liners protect surfaces subject to wear or corrosion.
- Shafts, sleeves, bearings and other parts are interchangeable.
- All working parts can be inspected or removed without disturbing piping connections.

SEND FOR CATALOG 1100-2-TA



DE LAVAL STEAM TURBINE CO., TRENTON 2, N. J.

DE LAVAL

TURBINES • HELICAL GEARS • CENTRIFUGAL BLOWERS AND COMPRESSORS
CENTRIFUGAL PUMPS • WORM GEAR SPEED REDUCERS • IMO OIL PUMPS

2

"We feel that heat seal adhesives will play a large part in the packaging field of the future. These adhesives can be applied to various surfaces and stored away for a period of time before using. When the converter uses these coated surfaces he can turn out a finished product at a very fast rate. He also eliminates the many problems of gluing that arise in the plant.

"The chemical industry has been making rapid strides in developing new transparent plastic sheetings. They began with coated glassines and cellophane. Now they have progressed to Sarans, Pliofilm, and Polyethylene. Glassine and cellophane can be adhered without too much trouble, but we have had quite a time with the latter films. We now have adhesives for Saran and Pliofilm which give excellent adhesion. Our real problem has been the sealing of Polyethyline. Polyethyline is resistant to alkali, acids, and up until now most adhesives. We have finally overcome this difficulty however, and have adhesives that will band Polyethylene to kraft, foil, and to itself. Polyethyline is not being used in very great quantities at the present time but we feel that it has great potentialities. This fact is borne out by the research programs being carried out by the large converters and by all of the adhesive manufactures.

"Other large fields requiring resins are water resistant foil laminations, acetate laminations and coatings for inked surfaces. Many breweries are using foil laminated labels to give their bottles a more appealing appearance. Naturally a water resistant adhesive is needed and several resins have been developed for this application. For many years converters have been laminating acetate to printed board, but recently there has been need for laminations of acetate to foil, pliofilm, and vinyl sheets. Several of these laminations are being made today and the outlook for the future is for more and more of these combinations. Along these same lines there are many manufacturers who are attempting to coat printed and plane surfaces with materials to replace acetate laminations. Several of these experimental coatings are being tested in various plants and we should have the answers in a short time. These coatings will not only give a high glossy finish but they will also be greaseproof and water resistant."

Taste and Odor in Paper

"Taste and Odor in Paper" was discussed at the April 21 meeting by L. B. Sjorstrom of Arthur D. Little, Inc., Cambridge, Mass.

R. L. Leaf, Jr., *Publicity Chairman*

Kalamazoo Valley

April 6 was Graphic Arts Day in Kalamazoo, Mich. The Kalamazoo Valley Section and the Michigan Division of the Superintendents Association participated in a joint full-day program.

In McCracken Hall of Western Michigan College the Pulp and Paper School was dedicated. This was followed by open house during which the facilities and equipment of the new school were inspected.

In the afternoon a Graphic Arts Forum was held at the Harris Hotel, Joe Martin of the Champion Co., discussed "Gravures' Place in the Graphic Arts Industry." Milton Zucker of the International Printing Ink Co. talked on "Developments in the Printing Ink Industry," and Thomas Liston of the Halloid Co., described "Xerography and Xerographic Printing."

A celebration dinner was held at the Hotel Harris in the evening with Norman Bearse of the Champion-International Paper Co., as toastmaster. The featured speaker was Robert H. Simmons of the Government Printing Office, Washington, D. C., who talked on "Printers' Paper Troubles." This talk was followed by an enthusiastic round-table discussion.

Empire State

Hudson River Valley District

The Hudson River Valley District of the Empire State Section visited the mill of the West Virginia Pulp and Paper Co., at Mechanicsville, N. Y., on April 20. In the evening at the Halfway House, near Stillwater, N. Y., Lawrence Woodside of the Albany Felt Co., Albany, N. Y., talked on "Woolen Felts in the Pulp and Paper Industry." This talk was followed by a general round-table discussion of press felt problems.

Metropolitan District

The final meeting of the season of the Metropolitan District of the Empire State Section was held at Fraunces Tavern, New York City, on April 11th. John B. Calkin of the University of Maine presided as Chairman.

K. Ivar Ekholm, National Aniline Division, R. T. Bingham, TAPPI, and Robert F. Emerson, Manifold Supplies Co., as members of the Nominating Committee presented the following slate of candidates who were elected by acclaim.

Chairman—Lewis S. Reid, Metropolitan Life Insurance Co., New York, N. Y.
Vice-Chairman—Henry Z. Mohrer, Federal Paper Board Co., Bogota, N. J.
Secretary-Treasurer—J. F. Butterworth, Socony-Vacuum Oil Co., New York, N. Y.

An enthusiastic vote of thanks was extended by the seventy members present to the Socony-Vacuum Oil Co., for its courtesy in sending out the meeting notices, to W. R. Willets of the Titanium Pigment Co., for the very fine meeting programs that he provided during the year and to Henry Perry of the *Paper Trade Journal* for his fine work as District Treasurer.

Northern New York District

The Northern New York District of The Empire State Section met at the Woodruff Hotel, Watertown, N. Y. on April 13, 1950.

The principal speaker was Henry J. Perry, Editor, *Paper Trade Journal*, New York City who discussed "The Importance of the Paper Industry to New York State." Mr. Perry's remarks follow:

"Paper is the most essential of all the manufactured ingredients of our civilization; its manufacture is the 6th largest of our industries, the No. 1 industrial producer of electrical energy, the No. 3 consumer of all power. It is a buyer of 10% of all chemicals, the 3rd largest user of our forest resources, and a major user of our water. Upon it, 1 out of every 212 employed directly depends for employment.

"Where does New York State stand in this industry? During the 22 years from 1927 to 1949 when there was an ever-increasing demand for pulp and paper, New York State's contribution to the total supply dropped from 14 to 8% in paper and from 17 to 5% in pulp, while others satisfied the demand.

"Why was this? It is well that we stop and survey the past so that we can chart a reasonable course ahead. We know that during the past 20 years many mills have closed; some have moved south and some, because of lack of foresight, have gone permanently out of business.

"In 1920 New York State employed 14,000 in its 136 paper mills; paid $21,000,000 to its employes; bought $74,000,000 in materials and supplies; and produced 1,457,000 tons valued at $124,000,000. This was 14% of the total U. S. production.

"Its 61 pulp mills employed 3400; paid them $4,800,000; bought $32,000,000 in materials and supplies; and produced 710,000 tons of pulp with a value of $24,500,000.

"In 1947 these paper mills had decreased to 115. However they employed 15,000; paid them $46,000,000; purchased $189,000,000 of needed goods; and produced 1,849,000 tons worth $440,000,000.

"The pulp mills had decreased to 44 with 3000 employes; with a payroll of $8,652,000; made purchases of $34,000,000; and produced a tonnage of 646,000 tons valued at $51,000,000.

"Added to this, we find that they also paid in 1947 federal taxes of $33,000,000; and state taxes of some $4,000,000.

"The state held its own (no small achievement for the conditions under which it operates) but it did not participate in the normal expansion of about 200%.

used on World's Largest Felt and Liner Board Machines

In South Gate, California and Clark, New Jersey, United States Gypsum Company is operating the two largest combination felt and liner board machines in the world. One has 8 vats and 91 dryers, 361 feet long. The other is still larger, with 10 vats, and 124 dryers, 435 feet in length—approximately the height of a 35- or 40-story skyscraper. Downingtown Manufacturing Company built both machines and called upon Manhattan to furnish all rubber covered rolls, rubber covered Oliver Saveall's and rubber hose . . . 37 tons of rubber are employed in these two huge installations for the production of roofing felt and liner for gypsum board.

These combination felt and liner board machines are producing the most difficult sheets to make on a cylinder machine. The two machines are using 150 rubber covered rolls (including spares) for suction, drum, cylinder couch, felt and press rolls. Rubber covering on rolls for these multi-million dollar machines has to be as nearly *perfect* and *permanent* as is humanly possible for skilled craftsmen to make it.

Manhattan roll covering engineers have made their reputations on the world's largest installations for over half a century. They have developed a permanent bond between rubber and metal. They have developed machinery and techniques for accurately controlling density and surface dimensions within thousandths of an inch. They analyze production conditions and tailor their recommendations to the individuality of *your* particular mill.

If you are not already relying on Manhattan Rubber Covered Rolls, investigate the services you can get from Manhattan's modern, experienced Roll Covering Department.

ROLL COVERING PLANTS AT PASSAIC, N. J. — NEENAH, WISC. — NORTH CHARLESTON, S. C.

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Manufacturers of Mechanical Rubber Products • Rubber Covered Equipment • Radiator Hose • Fan Belts • Brake Linings • Brake Blocks • Clutch Facings • Packings • Asbestos Textiles • Powdered Metal Products • Abrasive & Diamond Wheels • Bowling Balls

The present status was maintained by grade shifting, as evidenced by these figures:

Table I. Shift in Grades (Values in Per Cent)

	1927	*1937*	*1949*[a]
News	26	7	0
Book and groundwood	16	25	28
Tissue	6	9	15
Board	29	31	39
Wrapping	12	13	6
Other	11	15	12

[a] Calculated from Lockwood's Directory 1949.

"In pulp the situation has also remained nearly static. It is unfortunate that pulp consumption figures for 1927 are not available so we must start at 1939.

"The New York State mills produced 460,000 tons and consumed 911,000 tons, about 50% of requirements. To make this pulp required 872,000 cords of wood, a ratio of 1.24 cords per ton. In 1947, 1,127,000 tons was used, with local mills supplying 645,000 tons or 57%. This required 884,000 cords or 1.37 cords per ton.

"Of this wood used, only 204,000 cords in 1939 and 271,000 in 1947 came from within the state, the balance from New England and Canada.

"Actually New York State only produced within its own borders 18% in both 1937 and 1947 of its new fibrous requirements.

"Now let us examine for a moment where we stand in terms of people. Everyone in the vicinity has been through Piercefield. A town solely supported by a pulp and paper plant, when the wood was gone, so was the industry. It is now a broken ghost town. We have in this state potentially 23 towns like it, who depend 90% or more, 6 towns 70–90%, 11 towns 25–70% on our industry, with a total population of 68,000. Thus 40 towns can either be wiped out or seriously crippled by the loss of, or severe damage to, this business.

"In comparison with this static condition in our industry, all manufacturing within the state increased nearly 200%, based on value added by manufacture, during the 1939 to 1947 period. It is reasonably safe to say our markets expanded a like amount. This might be discounted 50% due to loss of the purchasing power of the dollar; however any way you want to figure it, industry in general has expanded within the state.

"As another means of comparison, pulp and paper spent some 20 millions for modernization within the state in 1947, paper convertors 16 millions, the publishers some 36 millions more, out of a total 497 millions. From this point of view it can be seen that industry has faith in New York State, pulp and paper only maintains the status quo.

"Thus you can see that pulp and paper is important to the general economy of small towns of the state, as a taxpayer, employer, and as a buyer.

"What about it as a consumer of paper for paper products? As closely as can be estimated, the consumption within the state on a very conservative basis is:

Table II. Estimated Paper Consumption 1947

Paper and paperboard products	$213,256,000
Total newsprint	157,591,000
Other printing and publishing	137,704,000
Job, commercial, lithography, bookbinding	87,500,000
	$596,051,000

"(Based on total cost of materials, fuel, and contract work × 0.99 equal materials × 0.75 = paper purchases or 74% of total is cost of paper or $596,051,000.)

"We find ourselves producing on a dollar basis (a poor yardstick at best) about 70% of our own local market. We know that no newsprint, no Kraft liner, and little corrugating is made here. We know that this state with its huge manufacturing establishment, larger by a third than any other state, is the most concentrated market for paper on earth.

"Here we stand in the largest concentrated paper and paper products market on earth, just holding our own, while the rest of the continent marches on. *Why?*

"There are many reasons but basically it is hard to make paper in New York. For example, consider:

Taxes

"New York is an expensive state in which to operate; it gives many benefits which cannot be afforded elsewhere. Most of these benefits are excellent in theory and are the result of progressive thinking, though often they are mismanaged. As an example, consider the Florida vacations at your expense for the unemployed. Now there is a new disability insurance; excellent in concept—how well will it be managed? If well, impartially, and strictly managed, fine; if not, and it turns out as a pension for gold bricks, New York State will be just that much harder to do business in.

Compensation Insurance

"Any right-thinking person wants to have the industrially injured given the best in medical care, and the economy of his family preserved. No payment can make up the cost of lost time to the employee, the anguish or even loss to his employer due to injury. Much can still be done by employers to lower this cost through accident prevention. Still more would be done if a merit system was legal as it is in Quebec, a healthy competitor. Our insurance premiums for paper mill work are $7.00 per $100 payroll, $17 per $100 for woods work. In Quebec under a mutual merit system they provisionally pay only $2.00 per $100 for paper workers and $3.00 per $100 payroll for woods workers. Actual costs are $0.92 for mills, $2.02 for woods. A heavy burden for us to bear. Their benefits are equal in most cases to ours. Some states have no such requirements, which may be morally wrong but nevertheless tough competition.

"Logging in New York State is so dangerous that no private carrier will cover it; it can be carried only through the State Fund.

Raw Materials

"The state lacks a progressive forest policy for its lands, be they private or public. Dr. Harper outlined their conditions at Bolton Landing last spring. With a sound policy whereby it would be financially worth while to raise trees as a crop, we could materially increase our pulpwood supply.

"However, nothing much can be done until 1958 when the next constitutional convention is due to be called. The present private lands are in such condition that state aid in various ways is necessary now; however this form of help appears to be unconstitutional. The public lands within the blue line are forever locked as a wilderness or more aptly as a jungle. Certainly these currently wasted resources will never be opened up under an enlightened management plan for the benefit of all, until private lands are intensively cultivated under the best known methods, and it is demonstrated that industry is working as tree farmers and not miners.

Water Supply

"The time is fast approaching when we must practice far more efficient water utilization. The Black River Valley is years ahead of most sections. Some day those far-sighted citizens who set up the regulating board system will be publicly acclaimed. At present they are publicly attacked. The present fight against more water for his area stems from groups similar to those who locked up the Adirondack lands. These groups, posing as sportsmen, have in turn aroused true sportsmen's organizations to help in the battle. Somehow the fact that their exclusive hunting preserves are posted against public use has escaped the prominent notice that it deserves.

"Coupled to the water supply problem and the forest management program is that of stream improvement. There is probably no industrial group more anxious to improve water conditions than the pulp and paper industry. However, the approach must be realistic and progressive. After a 100 years of indifference on the part of everyone, a problem of this magnitude cannot be corrected overnight. The present approach appears to be well legislated and capable of sound administration. It however must be remembered that productive industry is the only means of raising the necessary funds to pay for the municipal improvements as well as its own systems, thus a double burden is imposed on industry.

"It was the intention to review our past and find out where we are now, so that we can look ahead. From the foregoing we cannot paint a rosy picture of future progress; the best that we can say is that we are still about where we were 20 years ago. Where we go from here is essentially a *political* question.

"In being realistic we must recognize that corporations have no votes, and it is entirely up to the people affected to control the situation.

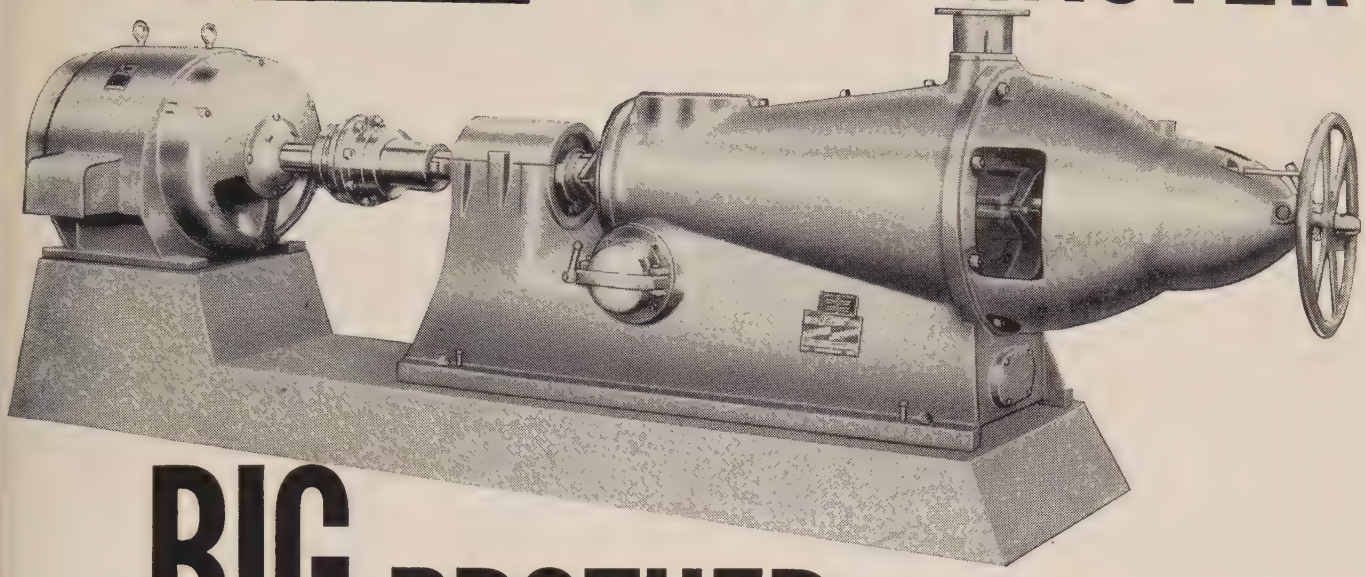
"The first step to do this is the development of a clear, clean, unbiased analysis of every bill or factor which affects the industry which employs you and your neighbors.

"Second, once this is developed it must be broadly distributed to all, and I do not mean just northern New York.

"Third and last you must see that your representatives know how you feel, and if they let you down, the vengeance should be quick and sure.

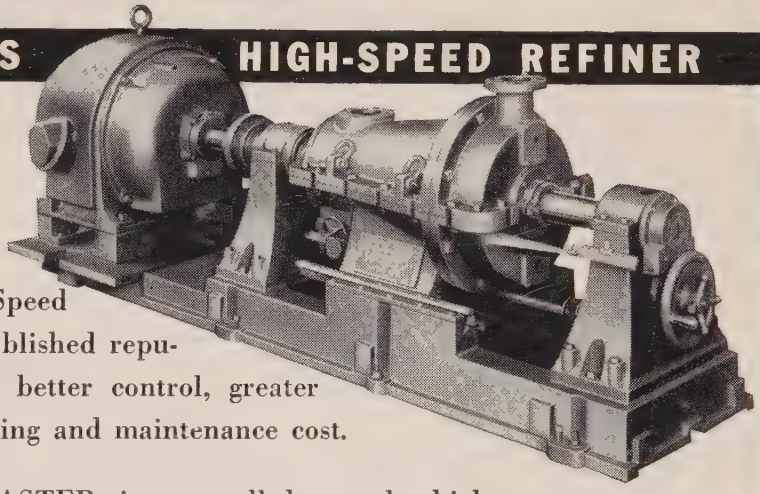
E.D. Jones

FIBRE-MASTER



BIG BROTHER

TO THE FAMOUS HIGH-SPEED REFINER



You know the Jones High-Speed Refiner. You know its established reputation for improved stock, better control, greater flexibility and lower operating and maintenance cost.

The FIBRE MASTER gives you all that — plus higher tonnage. The Fibre Master has twice the capacity of the High-Speed Refiner. It has a simplified, even more rugged design. Greater ease of maintenance because of easy disassembly (no need to disconnect piping to withdraw the plug, for instance). And it requires relatively little floor space.

If you have a problem in high volume refining, write for descriptive literature on the High-Speed Refiner and the Fibre Master.

E.D. Jones

E. D. Jones & Sons Company, Pittsfield, Mass.

BUILDERS OF QUALITY STOCK PREPARATION MACHINERY

"There is no time for mealy-mouth promises or weasel words. Now is the time for positive action. Appoint yourself a committee of one tonight to know what's going on, then talk it up to your neighbors, fellow employees, and even your boss. For until you realize that you have a common interest, your chances of being happy in your job together with the security of your mill are slim."

Change in Pulp and Paper Industry, Selected Years

Pulp Mills

Years	No. mills	Persons employed	Payroll, 1000's $	Value of Products, 1000's $	Materials and supplies, 1000's $	Tons
1927	61	3400	$4,864	32,957	24,518[a]	710,000
1929	39	2070	2,449	20,145	14,478[a]	460,000
1947	44	3061	3,652	51,417	34,336[a]	646,000
			Paper Mills			
1927	136	19,071	21,420	124,189	74,280	1,457,000
1937	115	14,465	20,466	110,550	...	1,415,000
1947	115	15,276	46,717	440,088	189,306*	1,849,000

N.Y.S. Production Ratio to Total U. S.

	Pulp, %	Paper, %
1927	17.2	14
1937	7.7	11
1947	5.4	8

[a] Includes fuel and power.

Discussion of Mr. Perry's Comments

Question: You talk about the heavy burden of taxation to carry the state program—woundn't state assistance in this reforestation program add a considerable amount?

Mr. Perry: I have seen some figures along that line. There was a study made and a report of the Lake Placid meeting on the cost of a deferrment—the state contribution of $500,000 would carry the program—I think that if we could it would be well worth the effort. A million or two in New York State budget doesn't amount to much. Any such sum spent by the state would be repaid many times over a period of years, by a number of methods.

Question: Wouldn't it be the responsibility of paper companies to develop their own forest program?

Mr. Perry: Indirectly, but our forestry problem in northeastern United States would be practically wiped out if it would be reasonably possible to raise trees on nonagricultural land at a profit, but it apparently cannot be done now.

Question: Isn't there some program whereby the owner of farm land can put in soft wood without being taxed until they start to cut?

Mr. Perry: The Fisher amendment, put through in which the assessment of land was fixed when you signed an agreement with the state to get its aid in reforesting land. Then when you cut the trees you pay 10% of the income from the wood in lieu of taxes. Taxes are not the whole answer. You have many problems. You have to have a constitutional amendment to make forest aid from the State possible. Under the present constitution, state funds and credit cannot be used for the benefit of private individuals or concerns.

Question: In connection with this tax matter, the lumber and the paper industry should be interested in the new tax law enacted in New Hampshire last year and which takes effect this year. The tax is assessed on the time that the wood is cut and not on the timber as it grows. It seems highly unintelligent for the northeastern states, not to give this matter serious consideration. I wonder what steps can be taken in applying that theory of taxation to long term crops—taxing land in anticipation of the future. A tree is not worth a nickel until it is cut. There is much discussion about our poor lands when it costs so much with no hope of recovering the initial cost. We should particularly be interested in finding an answer to the problem. I do not know what steps it would take to change an iron bound state to eliminate the waste due to state parks that are continuing to be a jungle operation. Due to the big fish and game associations who have been putting over the sob story that a tree must not be cut for fear of destroying food for a deer or a bear—something has got to be done to preserve this resource and eliminate the terrific fire hazard because of this mistaken so-called conservation and reduce much waste by taking out pulp wood that would otherwise only contribute to a crude dead fall, and still leave more room for growing trees. The public does not understand that what is being done is an archaic thing.

Mr. Perry: This N. H. law is an experiment, but a noble one. There will have to be much good management to make it work, but the New York legislature would first have to pass a constitutional amendment in order to pass a similar plan here. It would require a revolving fund from which the towns are paid for their loss of taxation, and in turn would be replenished to the yield tax. It works like this. When you cut the trees, 10% of the stumpage value is paid to the state. If you practice cutting according to the district forestry plan, a 3% rebate is given to the owner. This is a step in the right direction. However, is tax relief more important?

Question: If you read the up-state newspapers, you find the same people are writing in about the preservation of the public lands, I dare say most of the people here are members of some fish and game club, these clubs form a very powerful minority and I think that maybe something might be done about starting with these groups to influence them in changing their tactics.

Mr. Perry: I didn't want to bring up the subject, but what our industry needs is a public relations program, for it doesn't tell its story, forestry doesn't have any publicity on its side, neither does the lumber interests in this state. Something should be done about telling the public about the importance of the paper industry to the State of New York. At a meeting to discuss tax plans among the individuals interested in the welfare of the state there was only one man from the paper industry who could speak for his company. There were two woods managers who would have to report to their bosses on the discussions, but there wasn't any spokesman for our industry who could talk up our side of the problem. Most of them there were not aware of whether we produced one ton or a million tons of paper or whether the industry employed one man or 50,000 workers. A lot of our trouble is due to the lack of knowledge on the part of the people who are trying to solve the problems. Why doesn't the industry have a public relations bureau? I was told by the faculty member at the University of Maine that it was very difficult to get the students interested in studying for the pulp and paper industry there. The students knew about duPont and the importance of the chemical industry. They listened to the Steel Hour on the radio and the importance of that industry, but there wasn't enough information being passed out to interest them in the paper industry. We are missing the boat by not letting people know we exist. We must tell what we have done, what we are doing, and then we can get somewhere.

Western New York District

The regular monthly meeting of the Western New York District of the Empire State Section took place Wednesday, April 12, at the plant of the Spaulding Fiber Co., Tonawanda, N. Y. As guests of the Spaulding Fiber Co., approximately 50 members made a tour of the plant which has eleven acres of floor space devoted to the production of vulcanized fiber and laminated plastics. An interesting feature of the meeting was the display of the end uses to which these products were put.

Following the mill visit dinner was held at the Prospect House in Niagara Falls, N. Y. Norman Sixt of the Carborundum Co. introduced E A. Russell, Chief Engineer of the Spaulding Fiber Co. who gave a talk on "Conversion Products from Paper Materials." Mr. Russell, who has been with Spaulding for twenty-five years gave an instructive discussion of the two types of conversion to which paper is subjected at their plant. "In spite of the newer plastics," Mr. Russell stated, "the use of vulcanized fiber is increasing due to its low price, ready availability, and general utility."

Laminated plastic manufacture was begun by Spaulding in 1925 and has found wide acceptance. Actually vulcanized

From left to right: J. J. Forsythe, Irving Earle, E. A. Russell, J. S. Reichert, Norman Sixt, and Gordon Storin

PENN SALT

chemicals for the pulp & paper industry

Liquid Chlorine
Caustic Soda
Ammonia
Hydrogen Peroxide
Bleaching Powder
Sodium Aluminate
Acid-Proof Cement
Corrosion-Resistant Paints
Specialty Acid Cleaners

PENNSYLVANIA SALT MANUFACTURING COMPANY

1000 Widener Building, Philadelphia 7, Pa.

Appleton, Wisc. • Chicago • Pittsburgh • Cincinnati

Wyandotte, Mich. • Tacoma • Portland, Ore. • Los Angeles

Bryan, Texas • Paterson, N. J.

PROGRESSIVE CHEMISTRY FOR A CENTURY

fiber and laminated plastics are not competitive but actually supplement each other with the vulcanized fiber finding acceptance for lower cost uses and laminated plastics where resistance to water is required.

Following Mr. Russell's talk, an interesting display of samples illustrating uses of these materials was presented to the members. Irving Earle of the Upson Co., Lockport, presided at the meeting.

Pacific

The Shibley Award Contest, sponsored annually by Pacific Section, and a paper by F. B. West, Department of Chemical Engineering, University of Washington, provided an unusually interesting program for the Section Meeting at Camas, Wash., on April 7, 1950. Over 200 persons attended the afternoon technical session at the Camas High School Auditorium to hear papers presented by five young technical men from the pulp and paper industry in competition for the Shibley Award. A group of 60 college seniors and graduate students accompanied by faculty representatives were the guests of Pacific Section for the meeting following a visit to the Camas Mill of the Crown Zellerbach Corp. in the morning.

The Shibley Award was instituted by the Pacific Section in 1939 in memory of Kenneth Shibley, for many years prior to his death in 1937 a prominent chemical engineer on the Pacific Coast, and his efforts in behalf of young men in the pulp and paper industry.

John T. Firestone, Weyerhaeuser Timber Co., Pulp Division, Everett, Wash., was the unanimous selection of the judges in the 1950 contest for his paper "Salinity of Salt Water Borne Wood." Mr. Firestone was presented with a $50 award; all contestants received autographed copies of Sutermeister's "The Chemistry of Pulp and Paper Making" in recognition of their participation in the contest.

Harold C. Wall, Longview Fibre Co., Longview, Wash., was chairman of the program committee for the April 7 meeting and presided during the afternoon meeting. Howard C. Hall, Crown Zellerbach Corp., Camas, Wash., was in charge of arrangements.

John T. Firestone

Following the afternoon technical meeting the Crown Zellerbach Corp. was host to the TAPPI group at a reception in the Crown Willamette Inn. W. F. Holzer, Chairman of Pacific Section, presided at the dinner and introduced H. A. "Gob" Des Marais, General Dyestuff Corp., who gave an interesting account of his recent trip to Japan.

GET YOUR COPY

If you haven't already received a copy of this new bulletin on Bauer Pulp Refiners, we'll be glad to mail you one. The bulletin explains the construction and performance of Bauer No. 400 Series Pulp Refiners. It gives complete dimensions and data. It describes modified designs for special services, also auxiliary equipment.
While you're thinking of it, ask for Bulletin P-1.

THE BAUER BROS. CO.
SPRINGFIELD 99, OHIO

A summary of the technical program follows.

1. Shibley Award Papers:

"Determination of Total Solids in Ammonia Base Sulphite Waste Liquor by Conductometric Means," by Berry W. Bailey, Soundview Pulp Co., Everett, Wash.

Ammonia base sulphite liquors were evaporated and their conductivities determined at temperature intervals of 5°C. from 20 to 90°C. Cooks used contained wood to combined ratios from 18.9 to 23.3 and were cooked so that the combined at the blow varied from 0.13 to −0.11. The conductometric curves obtained indicated that the higher the total solids to ammonia ratio (expressed as combined) the lower the conductivity for the same per cent total solids. The amount of combined sulphur dioxide at the end of the cook had no effect (stripping of the waste liquor assumed). The variations in sulphate content were small and no effect was noted. These results indicated that conductometric determination of total solids should be accurate enough to serve as a valuable tool for control of evaporators under normal cooking conditions where the amount of combined is held relatively constant.

"Product Segregation in a Paper Mill," by William F. Farley, Crown Zellerbach Corp., Camas, Wash.

The Camas Mill, being a specialty mill, produces and converts over a thousand items of finished products. Eighty per cent of the mill products pass through five handlings before being loaded into rail cars. Only two of these handlings are under mill control. Today, customers are insisting that they receive products segregated. Examples were given showing the manner in which the Camas Mill approached its product segregation problem and the resulting improvements. This same method may be applied to the segregation problem in any mill.

"Salinity of Salt Water Borne Wood" by John T. Firestone, Weyerhaeuser Timber Co., Pulp Division, Everett, Wash.

In a closed sulphite process the accumulation of inorganic salts may present an operating problem. Logs transported in salt water pick up a considerable quantity of salt. The object of this investigation was to determine the amount of inorganic salt introduced into the pulping system at the Everett Pulp Mill of the Weyerhaeuser Timber Co. Approximately 73% of the chips used were produced from salt water borne logs. It was found that for each ton of air-dry chips charged to the digester, 5.1 pounds of salt were introduced to the pulping process. This is an average value and large variations in salt content do occur in the wood supply.

"Furnish Calculations on Beater Fed Machines," by William S. Milne, Publishers' Paper Co., Oregon City, Ore.

The purpose of this paper was to discuss some of the problems encountered in calculating furnish for beater-fed machines operating on mixed furnishes. The example given referred to the production of newsprint on a 122-inch trim fourdrinier. A description was given of the two different test methods used to determine the per cent sulphite furnished.

One method involved the use of weighed sulphite laps and the comparison of beater stock properties to the stock properties of the regular run. The other method was based on the charts drawn by the level recorders located on the groundwood and sulphite tanks feeding the beaters.

From the test results, the data were expanded to provide a method of estimating the sulphite percentage over the range of actual operating conditions. While there was some question as to the theoretical correctness of this procedure, the values checked reasonably with those secured from the level recorders.

It was concluded that accurate determinations of the

ANTI-OXIDANTS
EFFECTIVE, INEXPENSIVE, LASTING
SINDAR Corporation
Industrial Aromatics and Chemicals
330 West 42nd Street, New York 18, N. Y.
Branches: Philadelphia • Boston • Cincinnati • Detroit • Chicago • Seattle • Los Angeles • Montreal • Toronto

Talked to your Purchasing Agent lately?

Give your Purchasing Agent the facts about good calendering. Tell him the importance of using superior calender rolls—of the production advantages as well as the improved selling quality in paper.

Ask your Purchasing Agent to order one Butterworth Calender Roll for your stack. Time its extra hours of top-flight service. Compare the finish of the paper with previous finishes.

Many of America's leading paper mills have standardized on Butterworth Calender Rolls after making this test. We believe that the lower production costs and better quality work you get with Butterworth Rolls will influence your future buying.

Butterworth Calender Rolls are made of first quality materials and to exact specifications. They're pretested for strength, hardness and density before delivery.

We make calender rolls for all types of calendering in every size to your specifications. We can also refill your present rolls.

For full information, write or call H. W. Butterworth & Sons Company, Philadelphia 25, Penna. — Providence, R. I., 40 Fountain St. : : Charlotte, N. C., 1211 Johnston Building In Canada—W. J. Westaway Company, Hamilton, Ontario

Butterworth Calender Rolls

proportions in a batch-mixed furnish can be made from charts drawn by liquid-level recorders, and that, in one mill at least, the actual volume of slush components when measured by depth in beaters does not vary over a considerable range, thus making consistency the determining factor over final percentage.

"Nomographs and Their Application to Continuous Kraft Bleaching," by Emerick J. Dobo, Crown Zellerbach Corp., Camas, Wash.

Nomographs are used for rapid operational calculations by nontechnical personnel in the kraft bleach plant at Camas. The equations, for example of the important stages for 80 G.E. kraft using the Kamyr process are as follows:

$$\mathrm{Cl} = KRW$$

$$\mathrm{Na} = \frac{K'R\%}{C}$$

$$\mathrm{H} = \frac{K''RW^{1.5}}{C'}$$

where Cl is the chlorine demand, Na the caustic demand, and H the hypochlorite demand. K, K', and K'' are constants of the equations depending on the units used. R is the stock rate, % the percentage based on stock rate, and W the Wiles bleachability of the stock. C and C' are the concentrations of the caustic and hypochlorite, respectively.

The equation for the hypo stage was developed by the method of rectification. The methods of rectification and the basic equations for the nomograph were reviewed. The addition type nomograph with logarithmic scales was used for the graphic representation. These were illustrated and discussed.

2. "Design of Packed Absorption Towers," by F. B. West, Assistant Professor of Chemical Engineering, University of Washington, Seattle, Wash.

A review was given of conventional design methods for packed absorption towers and of alterations in the design methods which are required when the solute reacts with the solvent. The absorption of sulphur dioxide from air into water was used as an illustrative example.

The major design steps which would ordinarily be taken in the conventional design of an absorber to produce a specified concentration of aqueous sulphur dioxide were first reviewed. These included:

(a) Firming-up the original performance specifications.
(b) Determining the liquor temperature at the base of the tower and at a number of intermediate liquor concentrations by heat balances.
(c) Determining the sulphur dioxide partial pressure at the corresponding liquor concentrations by heat balances.
(d) Graphical integration of the mass-transfer rate equations to give the numbers of transfer units.
(e) Selection of tower cross section for a given type of packing to conform either with the optimum balance between tower cost and power consumption or else with 50 to 70% of the flooding velocity, whichever is lower.
(f) Estimation of individual film H.T.U. (height of a transfer unit) values for the gas and liquid films.
(g) Combination of the individual film H.T.U. into over-all H.T.U. to obtain the total packing depth required.

Possible complications in the above design procedures due to the reaction of sulphur dioxide with the water solvent to give sulphurous acid and bisulphite ions were then explored. The extreme cases of very rapid and very slow reaction rates were considered briefly. The intermediate case postulated by Whitney and Vivian of a reaction slow enough to be negligible during diffusion through the liquid film but fast enough to be substantially complete in the bulk of liquid beyond the film was then considered in detail.

Results obtained during a recent University of Washington

Engineering Experiment Station investigation on the absorption of sulphur dioxide in water were then presented. The results were compared on the basis of conventional design procedures, which assume instantaneous reaction between sulphur dioxide and the water, and, also, on the basis of Whitney and Vivian's intermediate case.

The annual meeting of Pacific Section was held May 11–13, 1950, at the New Washington Hotel, Seattle, Wash. This was a joint meeting with the Pacific Coast Division, American Pulp & Paper Mill Supts. Assn. and the Technical Section, Western Branch CPPA.

R. M. True, *Secretary*

New England and Maine-New Hampshire

The New England and Maine-N. H. Sections of TAPPI will conduct a jointly sponsored meeting on the subject "Theoretical and Practical Aspects of Stock Preparation" on June 23–24, 1950 at the Hotel Wentworth-By-the-Sea, Portsmouth, N. H. A technical program of unusual interest has been prepared by Norman I. Bearse of Champion-International Co., chairman of the committee, with the assistance of George Day, Brown Co., John B. Calkin, University of Maine, and H. E. Pratt, Pejepscot Paper Co.

On Friday afternoon, June 23, the theoretical aspects of stock preparation will be featured and this first technical session, with George Day as chairman, will include the following papers:

1. "Some Theoretical Aspects of Fiber Motions in Paper Making," by S. G. Mason, Pulp and Paper Research Institute of Canada, Montreal,P. Q.
2. "Some Observations on Paper Making Fibers," by W. V. Torrey, S. D. Warren Co., Cumberland Mills, Me., and by R. H. Doughty, Fitchburg Paper Co., Fitchburg, Mass.
3. "The Properties of Pulp as Related to Chemical Composition," by I. B. Douglass, University of Maine, Orono, Me.
4. "The Effect of Fiber Characteristics on Paper and Paper Making Properties," by W. Gallay, The E. B. Eddy Co., Hull, P. Q.

The second technical session, under the chairmanship of P. S. Bolton, Robert Gair Co., Uncasville, Conn., will comprise a panel discussion on stock refining equipment. Representatives from the Sutherland Refining Corp., Rice Barton Corp., John W. Bolton and Sons, Downingtown Manufacturing Company, E. D. Jones and Sons, Inc., Sprout, Waldron and Company, Inc., Shartle Brothers Machine Company and others will participate in the program. There will be a general discussion of the practical aspects of stock refining during the Saturday morning meeting.

Since this is the annual meeting time for both of the Sections, an opportunity will be given during Friday afternoon for each Section to meet separately for the election of its officers for the ensuing year and to carry out any other business which may be necessary.

The Wentworth-By-the-Sea is located on New Castle Island, on the rocky shore of New Hampshire, and is an ideal convention spot with its own nine-hole golf course, opportunities for swimming in a heated or a cold salt water pool, deep sea fishing, boat rides, and an ingenious pitch and putt course. Situated within its own private park, it looks out from a hundred-foot elevation upon Little Harbor and the open sea, from its frame of beautiful gardens. Those who attended the Maine-N. H. Section meeting at the Wentworth last June are enthusiastic about returning for the 1950 spring session.

Following the dinner Friday evening there will be entertainment and dancing. A real out-door clambake, with lobster, clams and all the fixings, is scheduled for Saturday noon, to be followed by sports events during the afternoon. A sports dinner in the evening, at which the prizes will be awarded, will terminate the meeting. For the ladies a special program is being arranged.

DICALITE

PAPER-AIDS

improve sheet formation—giving usual benefits without the disadvantages

One outstanding point regarding use of Dicalite paper-aids is that they produce a definite (often remarkable) improvement in sheet formation—WITHOUT INCREASING DENSITY and WITHOUT CAUSING SLOWER DRAINAGE. This one point alone has made Dicalite a valued material in many paper mills, because it can increase production, improve uniform quality and reduce operating costs.

Dicalite improves formation—not by chemical means because it is inert—but by physical action of causing a more thorough and uniform dispersion of fibers at the wet end during formation. This action is peculiar to diatomaceous earth, due to the structure of the particles. We will be glad to mail you full information or send a representative on request.

DICALITE DIVISION, GREAT LAKES CARBON CORPORATION

GLC

NEW YORK 17, N. Y. • CHICAGO 13, ILL. • LOS ANGELES 14, CALIF.

DICALITE

PAPER-AIDS FOR BETTER PAPER PRODUCTS

Photo, Courtesy J. M. Huber Corporation

Single Instrument Measures Smoothness, Porosity and Softness of Paper

You just interchange the lower test plates in the GURLEY-HILL S-P-S Tester to convert it into an instrument for testing either smoothness, porosity or softness of any type of paper, by measuring a given air-leakage over or through the paper.

This 3 in 1 laboratory "assistant" is simple to operate, quick and accurate, and a real utility instrument where printing quality of paper must be reliably measured.

Bulletin No. 1400 describes the S-P-S Tester as well as other Gurley paper testing instruments. It's worth writing for today. W. & L. E. Gurley, Station Plaza & Fulton Sts., Troy, New York.

Reservations should be made directly with the Hotel Wentworth, Portsmouth, New Hampshire. Rates are on the American plan. Arrangements are in charge of J. F. Wright, National Aniline Division, Allied Chemical & Dye Corp., Boston, Mass.

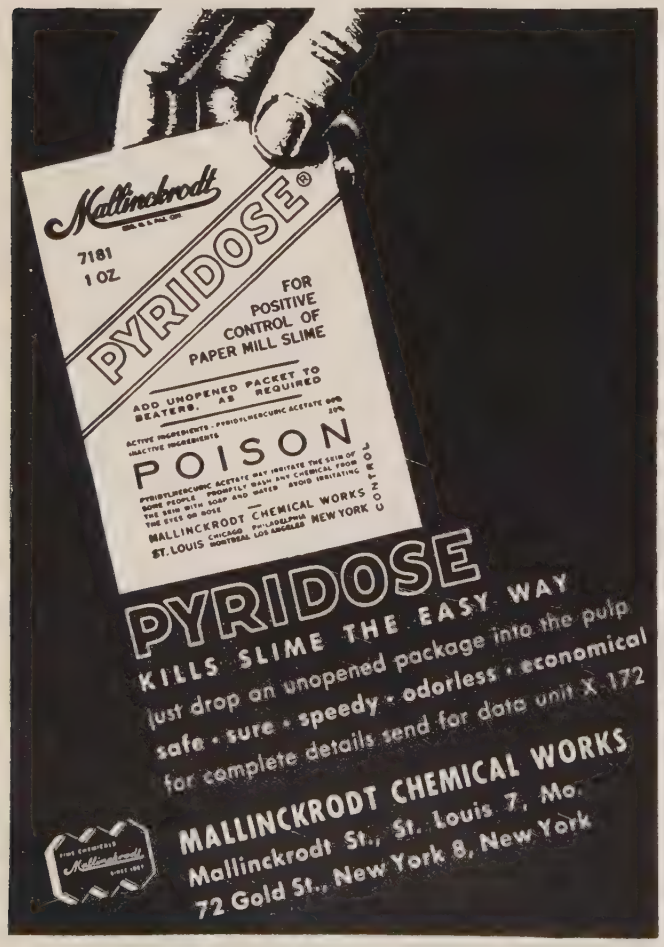
Chicago

The Chicago Section met at the Chicago Bar Association on April 17. Printing Inks was the general theme. J. Watson, Manager of Technical Service, J. M. Huber Corp., discussed "Printing Inks in General." R. H. Scott, Asst. Plant Manager of Sinclair & Valentine Co., talked about "Gravure and Aniline Inks," and Charles Bentner, Director of Offset Sales, Sigmund Ullman Co., discussed "Offset Inks."

Lake States

The Lake States Section held its April meeting on the 11th at Madison, Wis. G. H. Chidester and John McGovern arranged an interesting meeting at the Forest Products Laboratory on the subject: "Opportunities for Utilization of Lake States Woods for Coarse Fiber Products." The subjects presented by members of the Laboratory staff included mechanical fiberizing, cooking with steam and water and mild chemical treatments, and the use of the resulting products in roofing felts, wallboard, and corrugating board. As usual the tour of the Laboratory was a highlight of the meeting.

In the evening, at the Loraine Hotel in Madison, W. T. Wisniewsky, Director of the Committee on Water Pollution in Wisconsin gave an interesting talk on "Stream Pollution Control Activities in Wisconsin."


Mallinckrodt
PYRIDOSE®
7181
1 OZ.
FOR POSITIVE CONTROL OF PAPER MILL SLIME
ADD UNOPENED PACKET TO BEATERS AS REQUIRED
POISON
MALLINCKRODT CHEMICAL WORKS
ST. LOUIS MONTREAL LOS ANGELES NEW YORK
PYRIDOSE
KILLS SLIME THE EASY WAY
just drop an unopened package into the pulp
safe • sure • speedy • odorless • economical
for complete details send for data unit X-172
MALLINCKRODT CHEMICAL WORKS
Mallinckrodt St., St. Louis 7, Mo.
72 Gold St., New York 8, New York

DYESTUFFS
and
AUXILIARIES
for the Paper Industry

★ BEATER ★ CALENDER

★ COATING MACHINE

★ ANILINE PRINTING

Geigy
Dyestuff Makers
Since 1859

GEIGY COMPANY, *Inc.*
89-91 BARCLAY STREET, NEW YORK 8, NEW YORK

BRANCH OFFICES: Boston • Charlotte, N.C. • Chicago • Los Angeles • Philadelphia
Portland, Ore. • Providence • Toronto
IN GREAT BRITAIN: The Geigy Co., Ltd., National Buildings, Parsonage, Manchester

UNITED STATES PATENTS ON PAPERMAKING

Third Quarter, 1949

Compiled by CLARENCE J. WEST

The following list of patents has been compiled from the current numbers of the Official Gazette of the United States Patent Office. Because, as a rule, only one claim is published in the Gazette, it is not claimed that the list is complete; also, it is possible that the list may contain some patents that do not apply specifically to pulp and paper manufacture.

Copies of any of the following patents can be obtained from the United States Patent Office, Washington 25, D. C. by sending twenty-five cents for each patent desired.

July 5, 1949

2,474,862. Process and apparatus for continuous digestion of fibrous materials. John C. F. C. Reichter, assignor to Aktiebolaget Kamyr, Karlstad, Sweden. Filed Dec. 4, 1943. 2 claims. (Cl. 92-7.) The raw material is introduced into the digester at the inlet, liquor is introduced at the same point to fill the digester completely, and both are passed in unison through the digester while heat is supplied and the mixture is maintained under pressure higher than the vaporization pressure of the digester liquor.

2,474,944. Registering device for envelope blanks. Shala W. Henry, assignor to Boston Envelope Co., Dedham, Mass. Filed Jan. 12, 1946. 5 claims. (Cl. 271-2.) A mechanism is described for the positioning of envelope blanks so that the creases are correctly located.

2,474,968. Shipping package. Ralph L. Beach, Jr., assignor to International Paper Company, New York, N. Y. Filed Nov. 16, 1946. 5 claims. (Cl. 206-46.) A shipping carton for refrigerators is described.

2,475,014. Handgrip for carriers and cartons. Jay D. Crary, assignor to Paper Strap, Inc., Portland, Oreg. Filed Aug. 15, 1946. 2 claims. (Cl. 229-52.) A carton handle is so constructed that it forms a relatively flat wide gripping surface when in use.

2,475,052. Art of manufacturing composite commodity wrappers. Shy Rosen, assignor to Milprint, Inc., Milwaukee, Wis. Filed Sept. 8, 1947. 3 claims. (Cl. 229-87.) A reclosable composite bread wrapper of the telescopic separable-section type is claimed.

2,475,076. Apparatus for applying adhesive strip to cans or other containers. George K. Charles, Wincanton, England. Filed March 3, 1948. 8 claims. (Cl. 216-29.) A mechanism is described for applying adhesive strips to containers of various cross sections.

2,475,107. Shipping box. Kitchener K. Nesson, San Francisco, Calif. Filed March 6, 1945. 6 claims. (Cl. 229-15.) a box construction prevents objectionable bulging of the bottom.

2,475,236. Bag closure having pressure sensitive adhesive. Matthew Gollub, Philadelphia, Pa. Filed Jan. 10, 1945. 1 claim. (Cl. 229-62.) A structure for sealing paper containers or bags is claimed.

2,475,241. Heat-sealed bag. William A. Hermanson, Brookline, Mass. Filed Feb. 1, 1945. 6 claims. (Cl. 206-0.5.) A bag for a deodorant and the like may have one or both sides made of wet-strength paper; one side may be creped and used in conjunction with a heat-sealing web.

2,475,279. Corner lock construction. Robert M. Dunning, assignor to Waldorf Paper Products Company, St. Paul, Minn. Filed Aug. 12, 1944. 7 claims. (Cl. 229-36). Corners of a carton are so locked that outward pressure upon the walls cannot open the box without tearing it.

2,475,285. Method of preparing chlorine dioxide. Willis S. Hutchinson, assignor to Mathieson Chemical Corporation, New York, N. Y. Filed July 12, 1944. 5 claims. (Cl. 23-152.) Nitrogen dioxide diluted with air is reacted with an alkali or alkaline earth chlorite.

2,475,286. Method of preparing chlorine dioxide. Willis S. Hutchinson, assignor to Mathieson Chemical Corporation, New York, N. Y. Filed July 12, 1944. 5 claims. (Cl. 23-152.) Nitrogen dioxide diluted with air is reacted with an alkali chlorate.

2,475,294. Carton. Bennie A. Rafoth, assignor to Marathon Corporation, Rothschild, Wis. Filed Sept. 20, 1946. 1 claim. (Cl. 229-1.5.) Means are provided for retaining a spoon within the package.

2,475,323. Package wrapping. Bill Y. James, Miami, Okla. Filed Nov. 3, 1944. 4 claims. (Cl. 229-40.) Claim is made for a preformed package wrapping which may be placed about a package of predetermined size and shape.

2,475,361. Process of treating waste pulp liquors. Benjamin H. Thurman, New York, N. Y., assignor to Benjamin Clayton (Refining, Unincorporated). Filed March 6, 1946. 11 claims. (Cl. 260-97.7.) Black liquor is concentrated in a continuous flask evaporation step in which the liquor is kept in rapid movement in stream flow; the resulting mixture of soap and salt solution is easily separated in a centrifuge; a much cleaner separation is achieved by this method.

2,475,441. Self-locking coin box. John C. Abbott, Fort Lee, N. J. Filed May 26, 1948. 6 claims. (Cl. 229-8.5.) A self-locking coin bank is made from two blanks of paper or board and can be shipped in the collapsed condition.

2,475,480. Paper winding machine. Everett W. Clem and John P. Munton, assignors to Rice Barton Corporation, Worcester, Mass. Filed Nov. 15, 1946. 6 claims. (Cl. 242-65.) This refers to an improvement of the Pope reel.

July 12, 1949

2,475,617. Infusion package manufacture. Hans O. Irmscher, assignor to National Urn Bag Co., Inc., Long Island City, N. Y. Filed July 9, 1942. 15 claims. (Cl. 93-3.) A machine is described for the manufacture of tea bags.

2,475,626. Combustion retarding coating composition. Martin Leatherman, Bel Air, Md. Filed Sept. 24, 1945. 5 claims. (Cl. 260-32.8.) The coating composition includes acrylate or methacrylate ester polymers, polyvinyl chloride or a copolymer of vinyl acetate and vinyl chloride, zinc oxide, and an opaque pigment.

2,475,677. Folding carton having reclosable pouring spout. William A. Ringler, assignor to The Gardner Board and Carton Co., Middletown, Ohio. Filed Dec. 7, 1946. 3 claims. (Cl. 229-17.) In a pouring spout, the opening is confined to one wall of the carton.

2,475,691. Tension control mechanism. Gay M. Bonebrake, assignor to Wm. Wrigley Jr. Company, Chicago, Ill. Filed Nov. 2, 1945. 4 claims. (Cl. 271-2.3.) A control mechanism regulates the tension of a moving web by the variation in the speed of the web-feeding roll.

2,475,753. Stake for logging truck bunks. Oscar Nordberg and Charles B. Snow, Missoula, Mont. Filed July 22, 1946. 5 claims. (Cl. 105-384.) Bunk stakes are described for very heavy loads; a locking device permits release of the load only when operated intentionally.

2,475,766. Artificial fuel made from paper. Ralph O. Williams and Vladimir Bredlik, assignor to Williams-Bauer Corporation, New York, N. Y. Filed April 30, 1946. 5 claims. (Cl. 44-14.) Waste paper is used in the form of logs or briquets.

2,475,767. Method of making artificial fuel from paper. Ralph O. Williams and Vladimir Bredlik, assignors to Williams-Bauer Corporation, New York, N. Y. Filed April 30, 1946. 1 claim. (Cl. 44-10.) A method of treatment is given for waste paper to be used in the manufacture of artificial logs or briquets.

2,475,768. Method of extruding paper to form artificial fuel logs. Ralph O. Williams and Vladimir Bredlik, assignors to Williams-Bauer Corporation, New York, N. Y. Filed Nov. 10, 1947. 2 claims. (Cl. 44-10.) Paper is extruded in the form of a continuous form-retaining mass which can be separated into logs or briquets.

2,475,769. Method of making artificial fuel logs from paper. Ralph O. Williams and Vladimir Bredlik, assignors to Williams-Bauer Corporation, New York, N. Y. Filed Nov. 10, 1947. 8 claims. (Cl. 44-10.) Waste paper is treated for the manufacture of artificial logs or briquets.

2,475,781. Method of making construction material. Braxton E. Gallup, assignor to The Ruberoid Co., New York, N. Y. Filed April 20, 1944. 2 claims. (Cl. 154-88.) A weatherproof laminated building board has a porous or cellular core which contains a bituminous constituent and is adhesively bonded to the outer liner.

CLARENCE J. WEST, Member TAPPI; Chairman, Committee on Bibliography.

2,475,789. Method and machine for making corrugated structures. Bernard P. Kunz, Denver, Colo. Filed June 25, 1946. 19 claims. (Cl. 154-32.) A corrugated structure is manufactured in the form of a panel.

2,475,868. Rotary die creasing mechanism for corrugated paperboard. Nels A. Anderson, assignor to Fiberboard Products Inc., San Francisco, Calif. Filed April 13, 1945. 7 claims. (Cl. 93-58.1.) An apparatus is described for the roller die creasing of corrugated board.

2,475,869. Rotary refiner. Edmund P. Arpin, Jr., Neenah, Wis. Filed Jan. 12, 1946. 10 claims. (Cl. 92-26.) A rotary refiner consists of a stator, a plurality of centrifugally acting rotor elements for cooperation with the stator in effecting a refining action, and means for controlling the minimum clearance between the rotor elements and the stator.

2,475,913. Chick sorting and shipping box. Camille J. Notar, assignor of 50% to Raymond H. Notar, Westville, Ill. Filed Aug. 28, 1946. 1 claim. (Cl. 229-6.) A cardboard box is divided by partitions into sorting and counting compartments.

2,475,950. Apparatus for producing bags. Lewis B. Eaton, assignor to Pneumatic Scale Corporation, Limited, Quincy, Mass. Filed Oct. 2, 1945. 4 claims. (Cl. 93-3.) A mechanism for forming tea bags is claimed.

2,476,057. Mechanism for cutting, folding, and sealing the bottoms of bags. Harry A. Mead, assignor to Kono Mead-Equipment Corporation, Flushing, N. Y. Filed June 17, 1946. 2 claims. (Cl. 93-26.)

2,476,102. Display carton. Rolfe M. Lobell, Chicago, Ill., assignor to Leaf Brands, Inc. Filed Aug. 13, 1948. 5 claims. (Cl. 206-44.) The carton is adapted for shipping and display purposes.

2,476,131. Apparatus for dewatering papermaking stock. Roy H. Breyfogle, assignor to Cheney Bigelow Wire Works Incorporated, Springfield, Mass. Filed Jan. 31, 1946. 1 claim. (Cl. 92-43.) A rotatable cylinder in a vat is used for thickening the fibers.

2,476,181. Cellular container. Walton B. Crane and William B. Crane, Jr., assignors to Alpak, Los Angeles, Calif. Filed July 30, 1948. 9 claims. (Cl. 229-28.) A combination shipping, storage, and display container has a cellular partitioned structure.

2,476,197. Trihedral corner pad. Elbert B. Kincaid, assignor to Container Corporation of America, Chicago, Ill. Filed Feb. 28, 1948. 3 claims. (Cl. 229-14.) A paperboard blank is folded to provide a trihedral corner pad having triangular sides.

2,476,235. Fungus-proofing composition. Paul G. Benignus, assignor to Monsanto Chemical Company, St. Louis, Mo. Filed Aug. 11, 1944. 13 claims. (Cl. 260-21.) The product contains copper 8-hydroxyquinoline, a modified alkyd resin having a relatively high ratio of fatty acid to phthalic anhydride, and a mixture of chlorinated diphenyls. It is used as a water-in-oil emulsion.

2,476,253. Receptacle. Robert Van Rosen, New York, N. Y. Filed Feb. 5, 1948. 10 claims. (Cl. 229-35.) A corner-lock construction provides for securing the ends and sides of a container in corner-forming relation.

July 19, 1949

2,476,325. Method of making waterproof and moisture-vaporproof packages. William W. Rowe, assignor to Cincinnati Industries, Inc., Lockland Ohio. Filed April 23, 1943. 10 claims. (Cl. 93-35.) The package is essentially a bag made from paper creped by the positive adhesive action of a suitable binder, such as bitumen or some other thermoplastic or adhesive substance.

2,476,326. Strip trimmer. John Q. Sherman, by Katherine M. Sherman, et al., executors, Dayton, Ohio. Filed Aug. 3, 1940. 48 claims. (Cl. 164-61.) A paper-trimming apparatus removes the margins from continuous strips of marginally punched material.

2,476,450. Process for preparing a dry rosin size. Bert M. Morris, assignor to Hercules Powder Company, Wilmington, Del. Filed March 5, 1946. 5 claims. (Cl. 260-105.) Gum rosin is isomerized in the molten state with 0.01–0.10% of sulphuric or *p*-toluenesulphonic acid and is then completely saponified; the resulting rosin size is more stable toward oxidation than an untreated gum rosin.

2,476,564. Reclosable bread package having tear strip and reinforcing member. Shy Rosen, assignor to Milprint, Inc., Milwaukee, Wis. Filed July 5, 1946. 2 claims. (Cl. 99-173.) The construction of a bread wrapper is described.

2,476,577. Sheet separating mechanism. Headley T. Backhouse, Wentworth, England. Filed May 26, 1948. 15 claims. (Cl. 271-26.) The mechanism separates and feeds a single sheet of paper or a card from the top of a stack.

2,476,583. Container. Joseph P. Burgoon, Chicago, Ill. Filed June 30, 1948. 5 claims. (Cl. 229-16.) Containers for packaging and deep-freezing fruits and the like are constructed so that they may be internested after assembly and prior to filling.

2,476,623. Material packaging. Nels H. Petersen, assignor to Addison-Semmes Corporation, Racine, Wis. Filed May 7, 1948. 14 claims. (Cl. 206-62.) A package for handling and shipping fragile articles consists of an open-sided frame and pallets secured within the frame.

2,476,627. Container closure. John G. Rote, Jr., assignor to Sun Chemical Corporation, New York, N. Y. Filed April 6, 1948. 5 claims. (Cl. 117-76.) A coated paper liner is used as a component of crown caps and the like and as a facing for the interior of paper containers.

2,476,740. Envelope. Walter Krall, assignor to United States Envelope Company, Springfield, Mass. Filed April 26, 1947. 1 claim. (Cl. 229-80.) A sterile envelope is used for the packaging of surgical or medical bandages.

2,476,767. Container for photographic plates. William Rabkin, New York, N. Y. Filed Oct. 16, 1947. 3 claims. (Cl. 95-19.) A lightproof container is used for the storage and shipment of photographic plates; the wrapper can be removed by a drawstring.

2,476,802. Coating material. Walter F. Bollens, assignor to Swift & Company, Chicago, Ill. Filed Nov. 22, 1944. 5 claims. (Cl. 99-171.) The coating composition for food containers contains from 2 to 6% of levulinic acid; mold growth is retarded.

2,476,819. Method of producing GR-S latex containing carbon black. Rexford E. Draman, assignor to The Firestone Tire & Rubber Company, Akron, Ohio. Filed April 30, 1945. 1 claim. (Cl. 260-23.7). Sulphonated tall oil is an ingredient of the carbon black suspension.

2,476,845. Fluid for drilling wells. Reginald D. Dawson, assignor to Shell Development Company, San Francisco, Calif. Filed June 7, 1946. 4 claims. (Cl. 252-8.5.) A drilling emulsion is formed with lignosulphonic acid as the emulsifying agent.

2,476,923. Packaging for candy canes. Christos M. Sogas and Sam M. Sogas, Kansas City, Mo. Filed Feb. 24, 1948. 2 claims. (Cl. 99-180.) The canes are packed with 35 to 50 pound corrugated paper and sealed with adhesive tape.

2,476,948. Container. Roy S. Sanford, assignor to Autoyre Company, Incorporated, Oakville, Conn. Filed Feb. 3, 1945. 22 claims. (Cl. 211-73.) The material is slit to form a number of tongues having free inner ends; the slits terminate short of the edges of the sheet, leaving unslit marginal portions. The edge portions may be bent into face-to-face contact with the tongues and adhesively joined.

July 26, 1949

2,477,000. Synthetic fiber paper. Fay H. Osborne, assignor to C. H. Dexter, & Sons, Inc., Windsor Locks, Conn. Filed Aug. 22, 1946. 6 claims. (Cl. 92-3.) A thin, porous, lightweight tissue paper is formed of at least 90% unbeaten viscose fibers which are held together with 2 to 10% of highly hydrated natural fibers in water suspension.

2,477,111. Building wall structure. Abraham L. Austin, Oak Park, Ill. Filed Dec. 22, 1945. 1 claim. (Cl. 72-17.) The board is fabricated from Celotex, an asphalt mastic roofing paper, and a decorative coated composition of Portland cement.

2,477,157. Treatment of drilling fluids. Truman B. Wayne, Houston, Texas. Filed May 11, 1944. 11 claims. (Cl. 252-8.5.) A degelling- and/or viscosity reducing action on a drilling mud is produced by condensing and polymerizing tannins, lignins, and the like. The compounds are heated *in vacuo* at 180 °C. until all volatile products are removed.

2,477,174. Briquette for lighting fires. Georg Fosnaess, Gulsrud, Norway. Filed July 2, 1947. 3 claims. (Cl. 44-22.) Hard-pressed cardboard blocks are soaked in a mixture of 80% Diesel oil, 15% thick cod liver coil, and 5% tar.

2,477,196. Method of making pressure-sensitive adhesive sheeting. Wilfred J. Mohr, assignor to Minnesota Mining & Manufacturing Company, St. Paul, Minn. Filed June 12, 1945. 5 claims. (Cl. 117-4.) A water-dispersed adhesive is applied as an intercalated layer between two moisture-permeable backing sheets, the water is removed by evaporation, and the two adhesive sheets thus formed are separated by splitting the adhesive layer at its approximate center.

2,477,219. Method and means of preventing fluid loss through porous walls. Orien W. Van Dyke, assignor to Magnet Cove Barium Corporation, Houston, Texas. Filed March 21, 1947. 5 claims. (Cl. 252-8.5.) Comminuted wet-strength paper sized with bentonite is added to the drilling mud.

2,477,300. Decorative shelf edging. Edward Karfiol and William A. Roehm, assignors to Virtu, Inc., Brooklyn, N. Y. Filed May 12, 1945. 5 claims. (Cl. 154-47.) Printed paper is laminated with transparent plastic material and the product is passed through embossing and impressing rolls.

2,477,333. Ribbon reel made of a single blank. William H. Hawkins, assignor to Freydberg Bros.-Strauss, Inc., New York, N. Y. Filed May 8, 1946. 3 claims. (Cl. 206-51.) A packaging reel is described which can be assembled from a single blank.

2,477,339. Doctor mechanism for rolls and cylinders. Ernst R. Ljungquist, assignor to Lodding Engineering Corporation,

Worcester, Mass. Filed Feb. 14, 1945. 2 claims. (Cl. 92-74.) A doctor blade holder is so constructed that auxiliary pressure can be applied in varying amounts to localized areas of the free or back edge of the blade; thus, the blade fits closely to the surface being doctored.

2,477,344. Pregummed paper, fabric, and other materials. Salomon Neumann, assignor of 50% to Shand Kydd Limited, London, England. Filed Feb. 20, 1945. 2 claims. (Cl. 117-122.) The reverse side of the paper is coated with a starch suspension, the material is heated to a temperature such that the starch swells and becomes water soluble, and the product is dried.

2,477,530. Box. Lucien E. Vogt, assignor to Farrington Manufacturing Company, Boston, Mass. Filed May 26, 1948. 4 claims. (Cl. 229-8.) The box has external strengthening frames or members at the corners and along various edges.

August 2, 1949

2,477,604. Machine for impregnating webs. William E. Holland, Alexander J. Stanley, and James A. Chesnut, assignors to Industrial Tape Corporation, New Brunswick, N. J. Filed Jan. 11, 1945. 4 claims. (Cl. 91-31.) A method of internally bonding a fibrous web consists in the application of a bonding liquid to one side of the web, passing the coated web through rolls to expel air confined in the web, and then coating both faces of the web with the bonding liquid.

2,477,631. Catalytic bleaching with chlorites. Robert M. Levy and James E. Brennan, assignors to Ecusta Paper Corporation, New York, N. Y. Filed Feb. 21, 1945, 7 claims. (Cl. 8-105.) Pulp is treated with an aqueous solution of an alkali or alkaline earth metal chlorite and, as a catalyst, a small quantity of a water-soluble salt of cobalt, nickel, or manganese; the pH is maintained at 5 to 8.5.

2,477,787. Silicone insulating paper material. Harold S. Cook, Jr., Pasadena, Calif. Filed Nov. 15, 1945. 1 claim. (Cl. 229-3.5.) Cardboard is treated with hydroxychloro-organosilanes or covered with paper thus treated; styrene can be used in place of the silane.

2,477,793. Display package. Edwin W. Fuerst, assignor to Dow Corning Corporation, Midland, Mich. Filed May 20, 1948. 2 claims. (Cl. 206-45.28.) A container is so constructed that when opened, display panels open automatically.

2,477,902. Display box. Nicholas Scandore, Brooklyn, N. Y. Filed April 16, 1949. 3 claims. (Cl. 206-45.31.) A display box has a hinged lid secured to the rear wall which carries a transparent window.

2,477,912. Alginate containing adhesive compositions. Vance V. Vallandigham, assignor to Kelco Company, San Diego, Calif. Filed Dec. 11, 1945. 3 claims. (Cl. 106-208.) An adhesive paste consists of an amylaceous substance and from 0.2 to 2% of a water-soluble alginate.

2,477,922. Machine for debarking and trimming either standing or felled tree trunks. Walter B. Emery and Hugh Shuff, Birmingham, Ala. Filed Sept. 18, 1946. 6 claims. (Cl. 144-208.) The barker has driven means for moving the unit along a tree trunk and carries a rotary cutter for stripping the bark.

2,477,968. Package sealing machine. Earl B. Doolin, Dallas, Texas. Filed April 6, 1948. 8 claims. (Cl. 154-42.) A machine is described for heat sealing different sizes of bags.

2,478,113. Valve bag. Harry L. Lee, assignor to St. Regis Paper Company, New York, N. Y. Filed Sept. 28, 1945. 2 claims. (Cl. 229-62.5.) The extended portion of the intermediate ply forms a single-ply flexible valve flap extension which is pressed against the inside top portion of the bag by the contents.

2,478,132. Method of making loose-leaf binder case construction. Frank S. Schade, assignor to National Blank Book Company, Holyoke, Mass. Filed March 19, 1948. 6 claims. (Cl. 154-116.) A loose-leaf binder is made by laminating limp plastic sheets and panel inserts for stiffening the covers and backs.

2,478,150. Foam control in brown stock washing. Frank W. Young, Medfield, Mass. Filed Sept. 19, 1945. 3 claims. (Cl. 252-361.) Foam is avoided by multistage countercurrent washing of brown stock on a single filter.

August 9, 1949

2,478,181. Fibrous conduit and method and composition for same. Richard G. Coker and Auburn Woods, Jr., assignors to Sonoco Products Company, Hartsville, S. C. Filed July 28, 1943. 11 claims. (Cl. 138-78.) The paper plies in a tube are bonded with an adhesive containing a thermosetting resin and a carbohydrate, the tube is dried at 150–175 °F., and immersed in coal tar pitch at 300–315 °F.

2,478,240. Wet cutoff device. Peter J. Christman, assignor to Paper Converting Machine Co. Inc., Green Bay, Wis. Filed Nov. 12, 1946. 9 claims. (Cl. 164-66.) A high-speed web cutoff device has cooperating cutter rollers which are provided with coacting knives.

2,478,358. Container. Charles O. Ball, assignor to Owens-Illinois Glass Company, Toledo, Ohio. Filed May 19, 1945. 3 claims. (Cl. 229-38.) A paper blank is folded and shaped to form a rectangular tube which serves as the container body; an integral foldable portion is designed to form a closed end of the tube.

2,478,359. Paper container. Charles O. Ball, assignor to Owens-Illinois Glass Company, Toledo, Ohio. Filed May 19, 1945. 4 claims. (Cl. 229-38.) A paper container for liquids is provided which has a rectangular body and a closed bottom consisting of a single integral folded blank of sheet material.

2,478,360. Paper receptacle. Charles O. Ball, assignor to Owens-Illinois Glass Company, Toledo, Ohio. Filed May 19, 1945. 5 claims. (Cl. 229-38.) A paper container for milk or other liquid has a rectangular body and a bottom end folded from a single sheet of material.

2,478,379. Cellulose bleaching. Alfred M. Dodson, assignor to Hercules Powder Company, Wilmington, Del. Filed July 30, 1948. 15 claims. (Cl. 8-105.) The bleaching solution contains chlorine and from 0.03 to 16% of ammonia, an ammonium compound, or salts of amines; their use inhibits viscosity reduction during bleaching.

2,478,439. Method of impregnating fibrous articles. Rudolph H. von Liedtke, assignor to Line Material Company, South Milwaukee, Wis. Filed Sept. 4, 1945. 2 claims. (Cl. 117-65.) The material is evacuated and them impregnated with pitch or like material; the waterproof article has high-mechanical strength and high-dielectric properties.

2,478,485. Pad forming machine. John W. Hewitt, Jr., Neenah, Wis. Filed April 29, 1947. 17 claims. (Cl. 164-28.) An apparatus is described for cutting sanitary pads from a web of material fed between an assembly of die cutter rolls and a high-speed anvil roll.

2,478,631. Device for folding box blanks. Ernst Landolt, Neuchatel, Switzerland. Filed June 28, 1945. 4 claims. (Cl 93-49.) A plate of metal or other material is adapted to accept a light board blank while the blank is partly folded to receive the goods to be packed; the plate lends rigidity to the blank.

2,478,794. Cell case machine. Daniel R. Vail, assignor to Henry C. Tuttle, Boston, Mass. Filed July 16, 1945. 9 claims. (Cl. 93-37.) A machine is provided for assembling slotted partition strips in lattice form to make an insert for a container which will divide it into compartments for bottles.

August 16, 1949

2,479,031. Method of and apparatus for controlling papermaking machines. Alexander W. Tait, Jackson Heights, N. Y. Filed July 1, 1946. 9 claims. (Cl. 34-18.) A formed paper web is passed across a suction water-removing unit actuated by an electric current which is varied in proportion to the amount of water in the web and then through a heater drier in which the variation of the current changes the amount of heat applied to the drier.

2,479,050. Paper canmaking machine. Melvin H. Sidebotham, Newton, Mass. Filed March 21, 1945. 15 claims. (Cl. 93-39.2). A machine assembles one cylindrical paper sleeve over a similar sleeve and secures a paper bottom to the double-walled assembly.

2,479,094. Dual-toned metallic-coated web. John A. Bicknell, assignor to S. D. Warren Company, Boston, Mass. Filed Feb. 25, 1946. 13 claims. (Cl. 41-26.) An embossed dual-tone metallic-coated flexible paper web has a surface which carries a coating composition consisting of finely divided metallic particles and an adhesive.

2,479,207. Apparatus for forming plaster-keying depressions in plasterboard. George A. Buttress, Los Angeles, Calif. Filed May 11, 1946. 3 claims. (Cl. 25-44.) The apparatus is designed for forming depressions in plasterboard before the plastic filler has set and while the cover sheets of the board are still wet.

2,479,213. Carton. John W. Cox, assignor to Shellmar Products Corporation, Chicago, Ill. Filed Jan. 8, 1945. 7 claims. (Cl. 229-28.) A cellular egg carton is cut from an integral board blank.

2,479,235. Method of protecting cellulosic material. William H. Hampton and Vaughn R. Smith, assignor to California Research Corporation, San Francisco, Calif. Filed Oct. 9, 1944. 3 claims. (Cl. 196-22.) About 0.1 to 5% by weight of an oil soluble soap (e.g., lead tallate) is added to an asphalt roofing compound to prevent deterioration of the paper felt by the hot asphalt.

2,479,290. Laminating machine. Robert W. Auxier and Patrick Norelli, assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa. Filed Oct. 29, 1945. 2 claims. (Cl. 154-1.) The machine is designed to cure composite sheets in a high-frequency electrical field; means are provided for applying a progressively increasing pressure to laminated sheets which carry a resinous binder.

2,479,298. Wrinkle coating composition consisting of a mix-

ture of conjugated double-bonded oil and an aqueous emulsion of polyvinyl acetate resin. Nathan T. Beynon, assignor to New Wrinkle, Inc., Wilmington, Del. Filed June 9, 1945. 2 claims. (Cl. 260-23.) A wrinkle drying coating contains 100 parts of conjugated double-bonded oil and 10 to 50 parts of polyvinyl acetate.

2,479,303. Crease resistance testing. Ladislav Boor and Linton A. Fluck, assignors to American Cyanamid Company, New York, N. Y. Filed Sept. 2, 1948. 3 claims. (Cl. 73-100.) The apparatus is described.

2,479,357. Method of making electrical insulations. Lawrence R. Hill, Ernest Bindschadler, and John A. Campbell, assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa. Filed Jan. 10, 1945. 5 claims. (Cl. 154-80.) Coils of insulated conductor are wrapped in cellulosic sheet material and mica flake insulation, evacuated, impregnated with a completely polymerizable liquid, and treated to polymerize the liquid.

2,479,453. Container for and method of wrapping irregular objects. Harold Amatel, assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa. Filed Aug. 5, 1943. 10 claims. (Cl. 206-46.) A container is designed for shipping magnetrons.

2,479,456. Carton. William H. Arthur, assignor to Container Corporation of America, Chicago, Ill. Filed Aug. 24, 1944. 3 claims. (Cl. 229-14.) A method of forming a wrapped carton is described.

2,479,522. Maleic anhydride resinous copolymer. Franklin Strain, assignor to Pittsburgh Plate Glass Company, Allegheny County, Pa. Filed March 25, 1944. 4 claims. (Cl. 260-77.5.) A maleic anhydride resinous copolymer is suitable as a bonding and impregnating agent for laminated paper and textiles.

August 23, 1949

2,479,627. Container inspection window having light excluding shutter. William R. Kohl, Glenview, Ill. Filed Aug. 16, 1946. 2 claims. (Cl. 206-45.31.) A transparent window is provided for mothproof garment storage bags.

2,479,700. Device for holding food products and the like. Joseph H. Pritchard, Los Angeles, Calif. Filed Aug. 13, 1945. 7 claims. (Cl. 229-54.) The holder consists essentially of two pocket-forming members attached to a middle rigid element (corrugated cardboard).

2,479,739. Bail-carrying partition for cartons. Thomas J. Gorman, Jr., Newark, N. J. Filed Dec. 1, 1947. 2 claims. (Cl. 229-47.) A carton partition has an interlocking structure designed to receive bails for containers stored in the carton.

2,479,910. Display box easel cover. Bruce J. Davidson, assignor to National Biscuit Company, New York, N. Y. Filed July 17, 1944. 6 claims. (Cl. 206-45.2.) An easel for displaying a box is formed from the cover of the box.

2,479,983. Storage battery expander material and process for preparing the same. Alexander Stewart, Adrian R. Pitrot, and Eugene Willihnganz, assignors to National Lead Company, New York, N. Y. Filed June 15, 1943. 4 claims. (Cl. 136-27.) The product obtained by precipitation of sulphite waste liquor with a low concentration of a mineral acid and heating the mixture forms an active organic battery paste ingredient; 0.5% acid is used at 185°C. or 20% at 85°C.

2,479,994. Machine for setting up cellular cartons. James E. Annen, assignor to Sutherland Paper Company, Kalamazoo, Mich. Filed Oct. 31, 1945. 30 claims. (Cl. 93-37.)

2,480,010. Antifungus wrapper and method of pest control. Lawrence H. Flett, assignor to Allied Chemical & Dye Corporation, New York, N. Y. Filed March 27, 1947. 22 claims. (Cl. 99-171.) A coated paper contains 1–2% of a lower dialkyl dichlorosuccinate as an antimycotic agent.

2,480,067. Apparatus for preparing bast fibrous plants and process, James L. White and Herman W. Hawker, Teague, Texas; said White assignor of 50% of his interest to said Hawker. Filed March 11, 1946. 7 claims. (Cl. 19-6.) An apparatus is described for the separation of the bast fibers from ramie and similar materials.

2,480,096. Dispensing container with rotatable closure. Robert L. Hoffman, Tuckahoe, N. Y. Filed May 18, 1949. 4 claims. (Cl. 222-542.)

August 30, 1949

2,480,119. Disk pulp screen. Hervey G. Cram, Appleton, Wis. Filed Feb. 25, 1946. 4 claims. (Cl. 92-30.) In a disk pulp screen, a positive pulsation of the pulp through the screen plates acts to dislodge any foreign material (e.g., slivers) which, if allowed to collect on the plates, would retard the flow of acceptable pulp.

2,480,148. Catalytic bleaching process. Robert M. Levy and James E. Brennan, assignors to Ecusta Paper Corporation, New York, N. Y. Filed Oct. 14, 1948. 6 claims. (Cl. 8-105.) Pulp for cigarette paper is bleached with an aqueous solution of an alkali or an alkaline earth hypochlorite containing a water-soluble cobalt or nickel salt.

2,480,176. Method of assembling containers. Julius A. Zinn, Jr., Belmont, Mass. Filed Aug. 23, 1945. 8 claims. (Cl. 93-44.1.) A blank is folded around a mandrel and the bottom element is forced against the mandrel while retaining pressure against the entire side area.

2,480,177. Carton-forming machine. Julius A. Zinn, Jr. and Michael J. Wilson, Chicago, Ill.; said Wilson assignor to said Zinn. Filed Dec. 4, 1949. 13 claims. (Cl. 93-44.1.) The machine consists of a continuously rotating table which carries a number of carton-forming mechanisms and a conveyor above the table, the linear speed of which is synchronized with the tangential speed of the table.

2,480,206. Modified drying oil compositions, methods of making the same, and methods of coating and uniting sheet materials therewith. Leo R. Whiting, assignor to Bakelite Corporation, New York, N. Y. Filed Feb. 20, 1945. 20 claims. (Cl. 154-140.) Cellulosic sheets are impregnated with a liquid binder consisting of a conjugated fatty oil and a catalytic mixture of an oxy-compound of boron and an acid or its ester, formed into a sandwich, and subjected to heat and pressure.

2,480,352. Separable liner for tacky elastomers. John A. Bicknell, assignor to S. D. Warren Company, Boston, Mass. Filed Nov. 4, 1944. 6 claims. (Cl. 117-90.) The paper has a base coat of alkali silicate and a finely divided filler and a top coat of a mixture of 1–10 parts of a mineral wax binder and 10-1 parts of a water-soluble soap.

2,480,478. Synthetic rubber compositions. Nicholas L. Kalman, assignor to Pierce Laboratory, Inc., New York, N. Y. Filed Sept. 22, 1943. 9 claims. (Cl. 260-23.7.) The composition contains a butadiene-styrene copolymer, a semireinforcing furnace black, and sulphurized tall oil of sticky viscous consistency.

2,480,500. Bag for merchandising. George A. Moore, assignor to Reynolds Metals Company, Richmond, Va. Filed March 16, 1946. 2 claims. (Cl. 229-62.) A bag which can be hermetically sealed is formed of waxed or oiled paper.

2,480,542. Corner stitching machine. Peter Brehm, assignor to Downing Box Company, Milwaukee, Wis. Filed March 7, 1949. 11 claims. (Cl. 1-11.) The machine inserts metal staples around the corners of fiberboard containers.

2,480,587. Method of filling and closing cartons. Donald E. Marshall, Stanley R. Howard, and Francis R. Clark, assignor to Colgate-Palmolive-Peet Company, Jersey City, N. J. Filed Aug. 31, 1944. 18 claims. (Cl. 93-6.) A method is given for filling and closing a full package of a material such as soap granules or flakes.

2,480,602. Machine for decorticating fiber-bearing stalks and leaves. David E. Patterson, Philadelphia, Pa. Filed Aug. 26, 1944. 4 claims. (Cl. 19-30.)

2,480,729. Dispensing carton. Maurice C. Guest, assignor of one third to Audrey L. Guest and Calvin J. Guest, Pontiac, Mich. Filed Feb. 18, 1947. 2 claims. (Cl. 229-7.) The carton includes a flap which permits gum and the like to be dispensed singly.

2,480,790. Fireproofing composition. John Truhlar and Athan A. Pantsios, assignors to Rudolf F. Hlavaty, Cicero, Ill. Filed July 28, 1945. 1 claim. (Cl. 106-15.) The composition includes a mixture of chlorinated wax and chlorinated naphthalene with an organic phosphite.

September 6, 1949

2,480,851. Method for rapid manufacture of sheet lumber. Worth C. Goss, assignor to United States Sheetwood Company, Seattle, Wash. Filed Feb. 5, 1947. 6 claims. (Cl. 18-47.5.) Cellulosic fibers are formed into a pad, subjected to high-pressure steam (220–550°F.), and then to a pressure of 100–1000 p.s.i.

2,480,889. Hydraulic barker. Frank H. Swift, assignor to Crown Zellerbach Corporation, San Francisco, Calif. Filed Nov. 16, 1946. 4 claims. (Cl. 144-208.) A hydraulic barker is provided with a moving debarking nozzle for use on longitudinally moving slabs.

2,481,049. Apparatus for corrugating sheet material. Alfred J. Stamm and Harold D. Turner, Madison, Wis.; dedicated to the free use of the People in the territory of the United States. Filed April 16, 1947. 9 claims. (Cl. 154-30.) An apparatus is described for corrugating laminated plastics and the like.

2,481,057. Box stitching machine. Nicholas A. Young and Peter Brehm, assignors to American Machine Works, Racine, Wis. Filed Nov. 23, 1946. 1 claim. (Cl. 1-15.)

2,481,240. Method for producing chlorine dioxide. William H. Rapson and Morris Wayman, assignors to Canadian International Paper Company, Montreal, Quebec, Canada. Filed Jan. 11, 1946. 8 claims. (Cl. 23-152.) A continuous process consists in passing sulphur dioxide vapor and an inert diluent through an aqueous chlorate solution.

2,481,241. Method for removing chlorine from mixtures con-

taining chlorine dioxide and chlorine. William H. Rapson and Morris Wayman, assignors to Canadian International Paper Company, Montreal, Quebec, Canada. Filed Feb. 15, 1946. 9 claims. (Cl. 23-152.) Chlorine is removed from chlorine dioxide mixture by treating it with sulphur dioxide.

2,481,288. Carton closure. James Cage, assignor to Reynolds Metals Company, Richmond, Va. Filed Feb. 5, 1945. 1 claim. (Cl. 229-39.) A method of closing a carton with a tongue is described.

2,481,305. Apparatus for drying bagasse. Charles W. Fuller, Clewiston, Fla. Filed Oct. 4, 1945. 5 claims. (Cl. 263-26.) A tower is provided for drying bagasse, wood refuse, bark, and sawdust for use as fuel or for the manufacture of board or paper.

2,481,322. Stabilized bituminous emulsion. Paul E. McCoy, assignor to Stancal Asphalt & Bitumuls Company, San Francisco, Calif. Filed Jan. 11, 1946. 7 claims. (Cl. 252-311.5.) Asphalt emulsions are stabilized by the addition of sodium lignosulphonates.

2,481,356. Tall oil treatment. Ernest Segessemann, Wood-Ridge, N. J., and Nicholas M. Molnar, New York, N. Y. Filed April 20, 1948. 6 claims. (Cl. 260-97.5.) The unsaturated fatty acids in tall oil are degraded mainly to palmitic and myristic acids by heating the soap of tall oil with sodium or potassium hydroxide at 230–290 °C. and 5–20 atmospheres' pressure for six hours.

2,481,370. Bitumen coated surface and method of making. Jacob van den Berge, assignor to Shell Development Company, San Francisco, Calif. Filed March 25, 1946. 4 claims. (Cl. 117-92.) Paper and like materials are coated with at least two bituminous materials of different penetration indexes.

2,481,374. Bituminous emulsion. Vilas E. Watts and Lyndon G. Thompson, assignors to Stancal Asphalt & Bitumuls Company, San Francisco, Calif. Filed June 21, 1948. 10 claims. (Cl. 106-232.) An aqueous alkaline bitumen-in-water emulsion (preparation given with a pinewood resin as emulsifying agent) is useful as a sizing agent and for waterproofing paper.

2,481,380. Package. Harlan V. Anderson, Sr., assignor to Rapinwax Paper Company, Minneapolis, Minn. Filed July 4, 1945. 3 claims. (Cl. 229-14.) A frozen food package is formed of paperboard combined with a moistureproof, heat-sealable, metal foil lining material.

2,481,405. Carton. Robert M. Dunning, assignor to Waldorf Paper Products Company, St. Paul, Minn. Filed June 2, 1945. 6 claims. (Cl. 229-37.) During sealing, the inner flaps are supported so that external pressure can be applied against the top of the carton to seal the flaps without danger of folding the flaps inwardly.

2,481,408. Regeneration of caustic soda-sodium sulphide cooking liquor. Robert R. Fuller and Vernon Woodside, assignors to Mathieson Chemical Corporation, St. Louis, Mo. Filed Aug. 13, 1946. 3 claims. (Cl. 252-183.) Fresh kraft cooking liquor is prepared by adding to the green liquor a fused mixture of sodium carbonate and elemental sulphur.

September 13, 1949

2,481,486. Rotary molding machine. Boyd R. Abbott, assignor to Armstrong Cork Company, Lancaster, Pa. Filed April 10, 1943. 3 claims. (Cl. 92-61.) A molding machine is described for the production of insulating blocks from mineral wool, paper pulp, and a binder.

2,481,523. Building materials of high elasticity. Charles Mack, assignor to Standard Oil Development Company, New York, N. Y. Filed Oct. 9, 1946. 1 claim. (Cl. 106-202.) Wood pulp, cotton, or the like is bonded with a blend of aluminum naphthenate and asphalt having a softening point of at least 160 °F.

2,481,687. Hot melt coating composition. Martin Salo and Harold F. Vivian, assignors to Eastman Kodak Company, Rochester, N. Y. Filed March 30, 1946. 7 claims. (Cl. 106-181.) The composition contains 10–80% cellulose butyrate (butyryl content of at least 47%), 10–80% chlorinated biphenyl (more than 40% chlorine) and 3–40% of a plasticizer. The product is suitable for laminating and waterproofing.

2,481,855. Shipping container. Dennis I. McKenzie, assignor to The Moraine Box Company, Dayton, Ohio. Filed June 8, 1946. 2 claims. (Cl. 229-23.) The carton has a wall reinforcement which supports the weight of the packaged article.

2,481,871. Handhold and card pocket. Roy C. Potts, Tacoma Park, Md. Filed April 26, 1944. 3 claims. (Cl. 229-52.) A handhold pocket structure is provided for two-ply wall boxes such as egg crates.

2,481,959. Method of producing a suspension of fibrous material. Bengt G. Wåhlin, assignor to Svenska Cellulosa Aktiebolaget, Stockholm, Sweden. Filed Dec. 21, 1945. 1 claim. (Cl. 261-36.) A foamy suspension of cellulosic fibers in sulphite waste liquor is suitable for the manufacture of a highly porous fiberboard.

2,481,999. Mechanism for vibrating diaphragms of pulp screens. Millard F. Hayes, assignor to The Sandy Hill Iron & Brass Works, Hudson Falls, N. Y. Filed April 7, 1945. 1 claim. (Cl. 74-26.) The construction includes half housings which form a chamber in which a crosshead reciprocates up and down; an arrangement for sealing the chamber permits movement of the crosshead and the diaphragm member.

2,482,042. Oxycellulose products, their manufacture and utilization. William H. Van Delden and John B. Rust, assignors to Montclair Research Corporation, Montclair, N. J. Filed March 21, 1945. 3 claims. (Cl. 106-203.) The oxidation of cellulose by alkaline hydrogen peroxide is described; the products are at least partially soluble in dilute alkali.

2,482,078. Chlorine concentration limit indicator for chlorinating systems. Charles E. Wallace, assignor to Wallace & Tiernan Products, Inc., Belleville, N. J. Filed July 13, 1946. 3 claims. (Cl. 346-33.) A recording chlorine concentration limit indicator is adapted for use in connection with a chlorine injection system for the chlorination of aqueous liquids.

2,482,080. Seal conveyed letter opener. Robert T. Lacey, Spokane, Wash. Filed Dec. 30, 1946. 9 claims. (Cl. 229-85.) A miniature letter opener is attached to the back of an envelope by means of a gummed seal.

September 20, 1949

2,482,086. Resinous compositions and use thereof in forming electrical members and laminated products. Newton C. Foster, assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa. Filed April 1, 1944. 20 claims. (Cl. 154-43.) The laminating agent consists of 10 to 95 parts of vinylidene resin and 90 to 5 parts of a resin prepared from maleic acid or anhydride and castor oil and another vegetable oil.

2,482,087. Process for the polymerization of styrene and mono-allyl maleate. Newton C. Foster, assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa. Filed Dec. 29, 1945. 4 claims. (Cl. 260-78.5.) A laminating agent can be prepared by heating 98 parts maleic anhydride, 58 parts allyl alcohol, 104 parts styrene, 1.3 parts benzoyl peroxide, and 300 parts acetone.

2,482,118. Paper cutter. Robert J. Matthews, Hasbrouck Heights, N. J. Filed Oct. 10, 1944. 4 claims. (Cl. 164-61.) A paper cutter is designed to form a number of parallel slits in board or paper blanks.

2,482,142. Structural material of compressed resin impregnated paper sheets. Gardner H. Chidester, Parker K. Baird,

STOP Slime from Cutting into Your Profits!

UNCONTROLLED slime eats its way right through your profits unless checked by periodic, thorough cleaning of equipment.

Specialized Oakite compounds place the best in modern industrial chemistry at your disposal . . . help you keep plates, rolls, save-alls, piping, chests clean and free of trouble-making slime.

FREE Oakite suggestions for using those materials to get maximum cleaning speed and economy—yours for a call to your neighborhood Oakite Technical Service Representative. Contact him or write address below, for FREE booklet F-4647—facts about low-cost paper mill cleaning.

SPECIALIZED INDUSTRIAL CLEANING

OAKITE

TRADE MARK REG. U.S. PAT OFF

MATERIALS • METHODS • SERVICE

OAKITE PRODUCTS, INC., 68 Thames St., NEW YORK 6, N. Y.

Technical Service Representatives in Principal Cities of U. S. & Canada

George E. Mackin, Forrest A. Simmonds, Clarence O. Seborg, Mark W. Bray, and John N. McGovern, Madison, Wis.; dedicated to the free use of the People in the territory of the United States. Filed Oct. 2, 1943. 6 claims. (Cl. 154-45.9.) A paper-base plastic is formed with a phenol-, urea-, or melamine-aldehyde resin. Properties are given.

2,482,189. Safety match packet. Arne E. Konen and Sherman K. Warner, Hartford, Conn. Filed Dec. 31, 1946. 2 claims. (Cl. 206-29.)

2,482,236. Multiple impregnation of papermakers' felt. Orion W. Berglund, assignor to The Orr Felt & Blanket Company, Piqua, Ohio. Filed Sept. 19, 1946. 3 claims. (Cl. 117-140.) A felt is impregnated with an emulsion of butadiene-acrylonitrile copolymer containng 10 to 30% solids and curing at 200–225 °F.; the felt has improved abrasion resistance and wet tensile strength.

2,482,237. Impregnating papermaking felts with polyvinyl alcohol containing emulsion. Orion W. Berglund, assignor to The Orr Felt & Blanket Company, Piqua, Ohio. Filed Oct. 24, 1946. 6 claims. (Cl. 117-140.) A felt is impregnated with a mixture of polyvinyl alcohol and a synthetic resin or rubber.

2,482,265. Glazed synthetic resin structure. Desiré Gonda, Sittingbourne, England, Filed Aug. 2, 1946. 1 claim. (Cl. 154-43.) Paper, board, and the like is laminated with a thermosetting formaldehyde resin.

2,482,370. Boxmaking machine. Alfred L. Rosenmund, assignor to Stapling Machines Co., Rockaway, N. J. Filed May 16, 1945. 20 claims. (Cl. 1-8.2.) The operation of a stapling mechanism is described.

2,482,371. Box-stapling machine. Alfred L. Rosenmund, assignor to Stapling Machines Co., Rockaway, N. J. Filed Sept. 17, 1945. 20 claims. (Cl. 1-8.3.)

2,482,399. Handle for boxes. Wayne G. Bullock, assignor to Eagle Paper Box Company, Tacoma, Wash. Filed July 28, 1948. 6 claims. (Cl. 229-52.) A folding suitbox handle is connected to the box at both ends of the handle.

2,482,470. Method of and device for testing crease resistance. Russell D. De Waard and Charles R. Stock, assignors to American Cyanamid Company, New York, N. Y. Filed Oct. 11, 1946. 7 claims. (Cl. 73–100.) An apparatus is described for determining the crease resistance of textiles, which probably could be applied to paper.

2,482,498. Phenol-amine-formaldehyde resin. Fritz J. Nagel, assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa. Filed May 10, 1946. 6 claims. (Cl. 154–43.) A laminating resin is formed from a phenol, aniline, diphenylamine, and a formaldehyde.

2,482,499. Laminates embodying mixed phenol-arylamine-formaldehyde resinous products. Fritz J. Nagel, assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa. Filed May 21, 1946. 7 claims. (Cl. 154-43.) A laminating resin is formed of a phenol, a diarylmonoamine, and formaldehyde.

2,482,574. Reduction of viscosity of molten sulphur by means of resin acids. Alexander Bogrow and Alfred R. Johnson, assignors to Arthur D. Little, Inc., Cambridge, Mass. Filed Jan. 22, 1949. 4 claims. (Cl. 23-224.) The viscosity of molten sulphur (158 to 300 °C.) is reduced by the addition of tall oil containing 30 to 50% resin acids.

2,482,594. Method of preparing phenolic materials from lignin. Irwin Al Pearl and Louis E. Wise, assignors to The Institute of Paper Chemistry, Appleton, Wis. Filed April 1, 1946. 4 claims. (Cl. 260-600.) Soda lignin is oxidized with sodium chlorite in a hot, weakly acid solution. One product is 6-chlorovanillin.

2,482,609. Vacuum sealing machine. Samuel H. Berch, assignor to The Flexible Vacuum Container Corporation, Los Angeles, Calif. Filed May 15, 1947. 2 claims. (Cl. 93-6.) A method of filling and heat sealing paper bags is described.

2,482,627. Machine for making corrugated paper. Bryant W. Langston, assignor to Samuel M. Langston Co., Camden, N. J. Filed Jan. 22, 1946. 15 claims. (Cl. 154-31.) This relates principally to methods for driving the sheet-advancing and glueing rollers.

2,482,710. Process of reacting dicyandiamide and aniline. David W. Jayne, Jr. and Harold M. Day, assignors to American Cyanamid Company, New York, N. Y. Filed March 24, 1945. 1 claim. (Cl. 260-249.5.) The reaction product of dicyandiamide and aniline in the presence of zinc chloride, when condensed with an aldehyde, gives a laminating sirup and a product suitable for treating paper.

2,482,711. End-labeling attachment. Thormod Jensen, assignor to American Machine & Foundry Company, Brooklyn, N. Y. Filed Dec. 12, 1945. 8 claims. (Cl. 216-30.) A method is provided for severing labels of different lengths from a web.

2,482,712. Beater roll. Dwight E. Jones, assignor to E. D. Jones & Sons Company, Pittsfield, Mass. Filed Sept. 27, 1945. 3 claims. (Cl. 92-22.) A beater roll construction includes a member having longitudinal knives or cutting bars; it is rotatable relative to and coacts with stationary bars.

September 27, 1949

2,482,755. Flameproofing of fibrous material. Florence M. Ford and William P. Hall, assignors to Joseph Bancroft & Sons Co., Wilmington, Del. Filed May 29, 1945. 12 claims. (Cl. 8-116.2.) A mixture of 100 parts of urea and 50 parts of orthophosphoric acid is heated to 375 °F., cooled, and mixed with 75 parts of water, 7 parts of 28% ammonium hydroxide, and 10 parts of 37% formaldehyde.

2,482,756. Flameproofing of fibrous materials. Florence M. Ford and William P. Hall, assignors to Joseph Bancroft & Sons Co., Wilmington, Del. Filed June 10, 1944. 4 claims. (Cl. 8-116.3.) The flameproofing agent is similar to that of U. S. patent 2,482,755 (Sept. 27, 1949).

2,482,858. Cellulose purification. Mervin E. Martin and Morris Umansky, assignor to Celanese Corporation of America, New York, N. Y. Filed Aug. 13, 1947. 10 claims. (Cl. 8-105.) The method includes treatment with sodium hydroxide, chlorination, digestion with sodium hydroxide under superatmospheric pressure, and a final hypochlorite bleach.

2,482,869. Shipping package for heavy spools. Thomas R. Polglase and Henry J. Hoebeke, assignors to Anaconda Wire and Cable Company, New York, N. Y. Filed June 16, 1948. 1 claim. (Cl. 206-59.) A shipping package for heavy spools of magnet wire is made of vulcanized or plastic-impregnated fiber but preferably of heavy paperboard (0.25 inch thick).

2,482,895. Method of making paper yarn. Edward J. Brockman and Thomas M. Scruggs, assignors to Bemis Bro. Bag Company, St. Louis, Mo. Filed March 29, 1946. 6 claims. (Cl. 571-165.) A paper strip is softened with water, impregnated or coated with a thermosetting or thermoplastic resin and spun or twisted into yarn while the fibers are still soft.

2,482,908. Method for growing aerobic organisms. Raymond S. Hatch and Richard N. Hammond, assignors to Weyerhaeuser Timber Company, Longview, Wash. Filed May 16, 1945. 6 claims. (Cl. 195-107.) A method of growing yeast and like organisms in the presence of air is described.

2,483,030. Box. Edwin L. Arneson, assignor to Morris Paper Mills, Chicago, Ill. Filed Oct. 26, 1945. 4 claims. (Cl. 229-52.) A cardboard clothing box is provided with a removable, interlocking handle which can be inserted into the top wall structure of the box.

2,483,063. Carton forming device. Don Ray, assignor to

Arden Farms Co., Los Angeles, Calif. Filed Dec. 21, 1942. 6 claims. (Cl. 93-51.) Provision is made for folding and assembling a liner and carton blank in a single operation.

2,483,162. Container. George S. Vivian, assignor to Satona Limited, Edinburgh, Scotland. Filed Oct. 9, 1945. 2 claims. (Cl. 229-57.) A polygonal container for liquids and the like is provided with a bottom closure which is formed by folding over the lower portions of the container walls.

2,483,169. Receptacles with self-closing mouth. Emil Anderson, assignor to Electrolux Corporation, Old Greenwich, Conn. Filed Oct. 4, 1945. 2 claims. (Cl. 229-62.) A paper bag for vacuum cleaners has a self-closing mouth structure.

2,483,174. Sealable carton with multiple bottom. Jack R. Belsinger, assignor to Belsinger, Inc., Atlanta, Ga. Filed May 6, 1947. 7 claims. (Cl. 229-23.) A container for fruit, bottles, and the like has a double bottom and a body portion containing a handle structure.

2,483,198. Method of treatment of ligno-cellulosic material and product resulting therefrom. Horace W. Hall, Newton, Mass. Filed March 16, 1943. 3 claims. (Cl. 8-115.6.) Urea-formaldehyde glue is applied to the surface of lignocellulosic material, rock wool is applied to the surface, and heat and pressure are applied.

2,483,200. Pulp drainer. Anton J. Haug, Nashua, N.H. Filed March 24, 1945. 13 claims. (Cl. 100-47.) The pulp drainer is designed for easy disassembly and repair.

2,483,338. Chain-type cutter for debarking machines. Melvin Douglas, assignor to Harry A. Lowther Co., Chicago, Ill. Filed June 2, 1947. 2 claims. (Cl. 144-208.) A debarking machine has a shearing or drawing action which permits the bark to be stripped without injuring the surface underneath.

LETTERS TO THE EDITOR

Dry Indicator Method for Water Resistance

To the Editor *Tappi:*

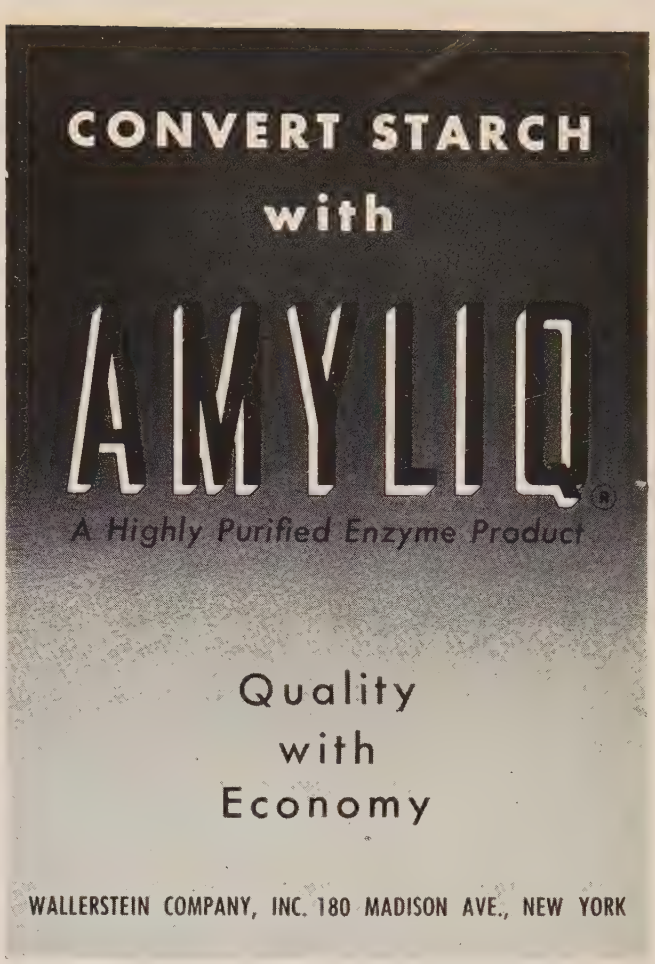
In *Tappi*, 32, No. 11, Nov. 1949, 501–505, F. T. Carson remarks that my "blind spot" criticism of the sugar dye test is based on the poor correlation between it and the ink penetration test. This just isn't so. Actually, I carefully explained that one test depends upon the rate of evaporation; the other upon capillary flow and therefore there can be no correlation.

My criticism of the test is based on the fact that it shows very rapid improvements as we increase rosin from very small to small doses and then shows no further improvement regardless of the amount of rosin added. The wet break test (which Mr. Carson brushes off) shows that there is really a large increase in temporary wet strength from these larger and larger doses of rosin. If a four or five times increase in wet tensile (even for only a minute or two) is not important, especially in some wet converting operations, then I apologize to Mr. Carson for this letter. The sugar dye test will miss this entirely.

The units will, of course, be different but the wet break curves as recommended, are practically perfect reproductions of the curve of water pickup vs. time for the same sheets. Data have been submitted showing this fact by myself and by Hercules in their paper on their light transmittance and reflectance apparatus. The reason why is known but has never been published.

If the water pickup vs. time curves, or the rate at which water enters and continues to enter the sheet isn't more important than knowing when the first water molecule gets through the sheet then I again apologize to Mr. Carson. The wet break tests gives the first mentioned results just as truly as water pickup data vs. times curves. Frankly, I doubt if I am the one who is confused.

W. S. Wilson, Research Dept. (Retired)
Monsanto Chemical Corp., Everett, Mass.



To the Editor *Tappi:*

In the discussion in my article, concerning Dr. Wilson's criticism of the dry-indicator method, there was no intention of deprecating in any way the excellent work that he has done and reported. I was certainly not conscious of "brushing off" the wet-break test (one of the methods of Group 3 of my article). The point is that the different types of tests, such as the wet-break test and the dry-indicator test, are incapable of measuring precisely the same thing. If one has a "blind spot," so do the others. Neither alone can tell everything one wants to know about water resistance.

The inference that Dr. Wilson's criticism is related to lack of correlation between dry-indicator and ink-flotation tests can surely be excused in view of the following quotation from Dr. Wilson's paper: "Since it (the ink-penetration test) is a measure of the over-all efficiency of the process, it is really a better relative measure of water resistance than most of the tests designed for the purpose."

The last paragraph of my article seems to state the case fairly, the first sentence of which reads: "There is room enough and need enough for all of the five types of water-resistance tests that have been discussed."

F. T. Carson
National Bureau of Standards, Washington, D. C.

Chipper Drives

To the Editor, *Tappi:*

1. It is not a case of disliking direct motor connection for chippers; it is rather a desire to design in accordance with the fundamental laws of transmitting power mechanically. Direct motor driving, regardless of the use of a torsional-resilient coupling, is a rigid connection, and rigid connection should not be employed where shock and vibration exist if premature wear and tear are to be avoided.

2. A friction-surface rubber belt requires greater tension, will slip more, and will create higher bearing friction than a mineral-retanned leather belt. These factors cause power loss and are the result of a difference in coefficient of friction of the respective belts. Rubber belting has a coefficient of friction of approximately 0.35, whereas that of mineral-retanned leather is 0.81.

3. It is possible to use a tensioning device on either rubber or leather belting drives, but, again, since rubber belting possesses a lower coefficient of friction than leather its use requires greater tension and a belt of greater width and thickness.

4. In view of 30 years' experience with all types of drives I would drive chippers with a flexible or shock-absorbing medium of transmission. Both V-belt and pivoted motor base flat belt drives will absorb the shocks and vibrations inherent in chippers. However, based on the higher efficiency and the automatic tension adjusting feature of the pivoted motor base drive, I prefer this drive. Both these drives can be designed to take the maximum torque of the driving motor, and the belt speed can be as desired. The result would not be clumsy.

We, too, here in America are favorable to direct motor coupled driving, but not at the expense of premature failure and shutdown.

WILLIAM STANIAR, Consulting Engineer
345 Brazilian Ave., Palm Beach, Fla.

Ed. Note: Mr. Staniar's comments are in response to a letter to the Editor (*Tappi* 33, No. 4, page 56A, April, 1950) by Torsten Samson of Stockholm, Sweden. The letters refer to a report of Mr. Staniar's talk published in the January, 1950 issue of *Tappi*, page 67A, etc. and given before the Hudson River District of the Empire State Section at Glens Falls, N. Y.

RECENT BOOKS

Scientific and Technical Abbreviations, Signs and Symbols. 2nd Ed. By O. T. Zimmerman, Univ. of New Hampshire, and Irvin Lavine, Industrial Research Service, Dover, N. H. 1949. Cloth. $5^1/_2 \times 8^1/_2$, 541 pages. $8.00 in U.S.A., $9.00 elsewhere.

Both authors of this reference book are professors of chemical engineering who realize the need for a common language in expressing technical terms. The information is given in 76 tables, covering over 3000 graphical symbols. Among the general subjects covered are chemistry, physics, engineering drawings, engineering materials, electricity and electronics, maps, acoustics, machine parts, etc.

Encyclopedia of Chemical Technology. Edited by Raymond E. Kirk and Donald F. Othmer, Polytechnic Institute of Brooklyn. Vol. 4. The Interscience Encyclopedia. New York. 1949. Cloth $7^1/_2 \times 10^1/_2$, 969 pages. $20.

As in the cases of Vol. 2 (June, 1949 *Tappi*. p. 74A) and Vol. 3 (July, 1949 *Tappi*, p. 80A) this review is prepared with the understanding that single volumes in the set of 10 are not for sale. Subscription to the entire set is necessary.

Volume 1 ended with anthone, Vol. 2 with carbon, Vol. 3 with cinchophen. Volume 4 begins with cineole and cinnamic acid and continues covering clays (with special reference to paper making), coal, coatings, colloids, color, conveying, corrosion, cotton, dairy products, correlation of data, detergency, ending with dextrose.

Since each subject is treated by an expert, the information given is of high value, covering manufacture, properties, and uses of each material.

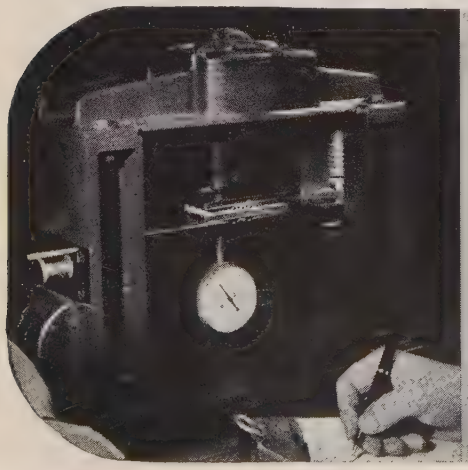
Subscriptions to the Encyclopedia may be made through *Tappi*.

Phillips Paper Trade Directory of the World. 1950 S. C. Phillips & Co., Graham House, 3 Tudor St., London E. C. 4, England. £2.2.0, postage extra.

With the growing interest of American concerns in the industry of Europe and other papermaking regions there is a need for a good directory of pulp and paper companies covering these countries. It gives the usual information about companies and their major machines, grade of paper made, etc. Although it would increase the size of the book considerably it would be of increased value if the names of one or two managing officials were included, at least for the British Empire companies that are treated more completely than those of other nations.

The Examination of Waters and Water Supplies. 6th Ed. By Edwin W. Taylor, Deputy Director of Water Examination, Metropolitan Water Board, London, Eng. The Blackiston Co., Philadelphia. 1949. Cloth. $6^1/_2 \times 9^1/_2$, 819 pages. Illustrated. $12.

This book in its previous edition is familiar to many readers of *Tappi*. It has been a reference book since its 1904 edition appeared. As in the case of most standard texts that have appeared in successive editions the contents have been revised and in the cases of the chapters on water-borne disease, bacteriology of water samples and disinfection of water supplies have been rewritten and extended. There are numerous tables and plates and a 41-page appendix of useful information relating to water. In view of the tremendous interest of the pulp and paper industry in water supply and use this book will be an important addition to every mill library.



The Hinde & Dauch CRUSH TESTER

TO CONTROL QUALITY OF PRODUCT—A practical, heavy duty instrument for ring stiffness tests of liner-board and box-boards and flat crush tests of combined corrugated board. Measurements uniformly accurate. Recording mechanism independent of machine elements, eliminating friction; plunger and plate free of lateral movement.

SCHOPPER TYPE TENSILE TESTER • BASIS WEIGHT SCALES
MICROMETERS • OTHER TESTING INSTRUMENTS
STRIP CUTTERS FOR UNCOMBINED BOARD TESTS

TESTING MACHINES INC.
427 WEST 42ND STREET, NEW YORK 18

REPORTS AND DISCUSSIONS

Presented at National and Regional Conferences

Terre Haute Meeting

The fourth annual meeting of the TAPPI Fibrous Agricultural Residues Committee was held at Terre Haute House, Terre Haute, Ind., on November 7 and 8, 1949. This was the second conference to be held at a mill site. The meeting was featured by a visit to the mill of the Terre Haute Paper Co. Samuel I. Aronovsky of the Northern Regional Research Laboratory, Peoria, Ill., and chairman of the committee presided. R. F. Burns, Vice-President of the Terre Haute Paper Co., and general chairman of the conference welcomed the group and announced that all present would be welcome as mill visitors. Dr. Aronovsky then pointed out the importance of attending these conferences and the benefits to the companies derived from the exchange of experiences and discussions on processing and control.

Technical Session—Monday, November 7

The technical session was started with a panel discussion on, "Straw Pulp Processing and Refining."

The first paper in the panel discussion was "Hydrapulper Processing of Straw" by C. E. Price and C. G. Krancher, Ball Brothers Co., Noblesville, Ind. Messrs. Price and Krancher reported the results obtained in their mill with a commercial Hydrapulper 11-feet in diameter for pulping straw for strawboard production. After some preliminary cooks, two runs were made to produce about 15–16 tons of pulp at each trial in the Hydrapulper. The cooks were made with 2400 to 2700 pounds of wheat straw in 90-minute periods, fill to fill, for approximately 1 hour at temperatures of 190–205 °F. After eliminating a few of the mechanical difficulties which always beset new operations in a mill, the process of producing pulp in the Hydrapulper worked quite smoothly. The data presented by Messrs. Krancher and Price indicated that this process is ready for commercial use; in fact, the results obtained with the larger Hydrapulper were superior to those obtained with the 3-foot laboratory unit. The power consumption in this operation was somewhat larger than that incurred in pressure pulping in rotaries, but Mr. Krancher explained that the Hydrapulper was not tied in directly with the washing and refining systems of the mill, and that there was, therefore, a considerable amount of lost motion and power that would be eliminated in a mill designed to use this process.

The second paper "Recent Developments with the Roll-Type Fiber Press" was given by L. F. Herman of the Fulton Iron Works Co., St. Louis, Mo. He described briefly the operations of the roll-type presses in the Quincy, Illinois, mill of the Central Fibre Products Co. and in the Carthage, Ind., mill of the Container Corporation of America. He described some results in pressing straw and flax tow pulps in the 3-foot press set up in the yard of the Fulton Iron Works Co. in St. Louis. He also gave the results obtained by using this press to chop straw, and he pointed out the advantages of chopping with this press which flattens the straw, and crushes the nodes, rachises, and large weeds. The charge in rotary cookers can be increased by about 30% when using straw chopped in this manner, as compared with the use of regular whole straw. This press is very efficient in removing water from pulped straw, resulting in a sheet of pulp containing 50% solids as it emerges from the press.

Lee E. Eberhardt of Bauer Brothers Co., Springfield, Ohio, next discussed "Revolving Disk Mills in Straw Pulp Production," by C. K. Textor and L. E. Eberhardt. He described the process used in the pilot-plant laboratory at Springfield, Ohio, involving feeding chopped straw simultaneously with cooking liquor into a single disk refiner, discharging the soaked mass into a container in which the temperature was raised gradually to about 200 °F. and allowing the material to remain at that temperature for about 1 hour. Afterward, the mass was reprocessed, without washing, through a double disk refiner with flat plates. The pulp discharged from the refiner was then washed. The resultant pulp was lighter in color and somewhat stronger than the conventionally cooked straw pulp intended for corrugating paper.

In a talk entitled "Bauer Refining of Straw Stock," J. R. Little of Hinde and Dauch Paper Co., Sandusky, Ohio, told of their experiences in pulping in a 8-foot Hydrapulper and refining the pulped straw in a double disk refiner. Mr. Little corroborated in general the results reported by Messrs. Price and Krancher. Mr. Little and D. L. Owen, superintendent of the Hinde and Dauch mills, were quite pleased with the results obtained with the mechano-chemical process.

"Refining Straw Pulp," a general discussion on refining in the strawboard and paper industries was given by J. R. Ayers of E. D. Jones and Sons, Inc., Pittsfield, Mass. He was followed by H. M. Sutcliffe of the Northern Laboratory who described briefly the work and results to date of the strawboard industry-Northern Laboratory collaborative research program for improvement of quality of strawboard pulp.

The general discussion of these papers with the authors forming a panel, was postponed until they had all been read. D. L. Owen (Hinde and Dauch Paper Co.) inquired if the rate of feeding straw into the Hydrapulper was governed by the capacity of the unit. Mr. Krancher replied that it took approximately 10 minutes to load 30 to 35 whole bales with the wires removed. The best charge was about 2800 pounds, dry basis, at a consistency of approximately 10%. A larger amount of straw at a higher consistency did not work as well. In partial reply to Mr. Owen's question, Dr. Aronovsky referred to a trial run in a 16-foot Hydrapulper, designed for defibering waste paper, into which 77 bales of whole straw were added before floating of the straw occurred. T. Agronin (Shartle Brothers Machine Co.) added that improvement in design, particularly an increase in the size of rotor, will help in wetting the straw more rapidly. In reply to P. E. Burchfield (Wyandotte Chemical Corp.) regarding the possibility of using a wetting agent, Mr. Krancher stated that it did not seem to give any particular benefits. H. P. Espenmiller (Dilts Machine Works), who assisted in the work carried out at Noblesville stated that the increased temperature of the liquor in the Hydrapulper during loading of straw was highly advantageous in speeding up the rate of loading. Best results were obtained when the temperature in the Hydrapulper was above 200 °F.; a temperature of 170 °F. slowed the operation considerably. Questioned by Dr. Aronovsky on the effect of the cold straw added to the hot liquor, Mr. Krancher said that steam was fed into the pulper along with the straw and there was actually a temperature increase during this period.

A. G. Gibson (Shartle Brothers Machind Co.) asked if there was any difference in power consumption in loading the Hydrapulper with chopped or with whole straw. Mr. Krancher replied that no comparative power measurements on pulping whole or chopped straw were made, but there was a drop from 135 to 150 hp. for the first 10 minutes of operation to 90 to 95 hp. for the remainder of the cooking period, when using whole straw. Dr. Aronovsky pointed out that while it is difficult to translate power requirements from the 3-foot Hydrapulper to the larger commercial units, whole straw required more power than chopped straw in the small machine. In reply to Mr. Burns (Terre Haute Paper Co.). Mr. Krancher said that abont $1^1/_2$ hours was the longest time used in these runs, fill to fill. He also estimated that two 16-foot Hydrapulpers equipped with 250 hp. motors would supply the straw pulp requirements for a 100-ton mill; about 350 to 400 hp. days per hundred tons would be required. This estimate was based on the use of 30 to 40% scrap corrugated material in the machine furnish.

E. C. Lathrop (Northern Regional Research Laboratory) pointed out the need for fundamental research on the principles of the Hydrapulper action. He also suggested, on the basis of preliminary laboratory work, that it might not be necessary to operate the rotor of the unit for the full cooking period. A shorter cooking period followed by hot storage in a chest as indicated in Mr. Eberhardt's talk might be satisfactory in that cook-

ing might be completed in the chest with a resultant saving of power.

Mr. Burns inquired whether the group agreed that lower freeness of straw stock gives a stiffer sheet. Mr. Krancher replied that the slower pulp produced in his mill did not give stiffer paper. R. W. Shew (Ball Brothers Co.) stated that the correlation of freeness on the machine wire with stiffness of the dry paper depends largely on cooking the whole straw to a point where it can be well and easily hydrated. Stiffness will vary with the freeness. Raw stock is brittle and does not have good bending qualities. Raw stock will also produce a harder sheet. Dr. Aronovsky pointed out that freeness was not due to any single factor: in raw, brittle stock lower freeness is due largely to debris produced in beating and refining; in well-cooked straw, on the other hand, the freeness is also reduced by the higher degree of swelling of the fibers; in both cases, freeness can be increased by suitable washing of the pulp to remove the debris and the very fine fibers produced in refining. W. D. Lewis (Muskingum Fibre Products Co.) believes that the degree of hydration is the answer to control of freeness on the machine and of stiffness in the final sheet. The problem is to determine suitable degrees of hydration in each mill since all mills do not have the same refining and papermaking equipment; freeness suitable for one mill may not be satisfactory for another. Freeness and softness are controlled by the degree of hydration. In over-hydrated pulps it is difficult to remove the water uniformly from the pulp, resulting in slower operation and in poorer formation of the paper. Dr. Lathrop stated that it is apparent from the survey made earlier this year that the stocks from various strawboard mills were not sufficiently refined or hydrated. The mills should take advantage of the high hemicellulose contents of straw pulp which govern the rate and degree of hydration. Dr. Lathrop thought consideration should be given to blending raw and well-hydrated pulps in suitable proportions, which will have to be determined by actual test, to produce a sheet with optimum strength properties. Proper refining of the pulp is extremely important.

L. V. Forman (Institute of Paper Chemistry) asked if the steam consumption figures included the steam necessary for preheating the liquor as well as maintaining the temperature in the Hydrapulper. Mr. Krancher replied that the figures given in his paper indicate the total steam consumption of the process up to the paper machine, and that these values are reliable since the recording meter on the steam line had been calibrated prior to the test runs in the Hydrapulper. In reply to Dr. Forman's inquiry regarding the properties of the finished corrugating paper in the final boxboard, Mr. Krancher said that tests were being run on the finished board but they were not as yet completed. He said, however, that the commercial corrugator ran very well on Hydrapulper straw—waste corrugating blend. An all-straw furnish with no waste paper gave some difficulties on the corrugator. Mr. Krancher estimated that the consumed horsepower was about 20 hp. per ton. This includes the power for the extra equipment used in this run, which would not be required in a mill properly designed for this process.

Dr. Forman then discussed pulping and testing. He agreed with Dr. Lathrop on the need for evaluating the pulp in order to determine how to treat it properly. Freeness is empirical and good for control work. It is, however, limited in its ability to measure directly any property of the pulp. It is possible to make changes on the wet end which have no effect on freeness or drainage rate, and yet will change the characteristics of the paper produced at the dry end of the machine. In some cases the value of the Riehle test can be correlated with the stiffness of the finished board, in others this does not hold. Sometimes even the flat crush test shows a reversal. At the Institute of Paper Chemistry the laboratory corrugator, which is a regular corrugator, but of narrow width, gave results that correlated fairly well with those obtained in commercial corrugating operations.

In reply to Mr. Knack's (River Raisin Paper Co.) inquiry about the consistencies used in the Hydrapulper runs, Mr. Krancher stated that the consistency of pulp to the Bauer refiner was about 3%. In feeding the Bauer the pulp was conveyed over a perforated plate, resulting in a consistency of 8–10% at the Bauer feed. He believes that the consistency to the Bauer was too low and that washing on the drainer conveyor was unsatisfactory. Mr. Little (Hinde and Dauch Paper Co.), in partial reply to Mr. Knack's question, stated that the stock in their experimental mill was pressed to a consistency of about 12% for feeding the Bauer.

Mr. Knack also asked if stock at 10% could be fed to the roll press. L. F. Herman (Fulton Iron Works Co., St. Louis, Mo.) said that the sugar press could operate on stock fed to the machine at a consistency as low as 8%. He pointed out, however, that the higher the consistency of stock fed to the press, the greater will be the rate of dewatering and, therefore, the greater the production through the machine.

In reply to Dr. Aronovsky's inquiry if a short period in Hydrapulper operation followed by quiescent boiling had been tried, Mr. Little said that after running the Hydrapulper to obtain good impregnation, the pulp was left quiescent in the unit for 1 hour before dumping. The resultant pulp had the same freeness as when the Hydrapulper was run throughout the entire cooking period. All of the pulps had low freeness, and washing did not free up the stock very much. Dr. Aronovsky pointed out that the action of the Hydrapulper apparently hydrates the straw more rapidly and to a greater extent than is obtained in pressure cooking. The one-half hour kraft cooked pulp had lower freeness than the 2 hour pressure-cooked pulp, using the same amount of chemicals. C. E. Price (Ball Brothers Co.) told of cooks made in the Hydrapulper for 1/2, 3/4, 1, 1 1/2, and 2 hours. The 1/2-, 3/4-, and 1-hour cooks gave pulps with approximately the same stiffness; with longer cooking periods the pulp stiffness was reduced. Mr. Krancher interposed that the 1-hour cook gave a pulp with fiber bundles short enough to be handled in the refining equipment used. Referring to work done at the Northern Regional Research Laboratory, Dr. Aronovsky stated that removal of the largest portion of the lignin and ash from the straw occurred in the first 15 minutes of cooking in the Hydrapulper.

Mr. Kastetter (Stone Container Corp.) said that the strength of the finished corrugating paper is directly related to the quality of the raw straw used. J. J. Fiori (Stone Container Corp.) suggested the simultaneous addition of straw and hot liquor to reduce floating in the Hydrapulper and, consequently, to shorten charging time. Mr. Krancher stated that he was prejudiced against chopping the straw as a separate operation. However, chopped straw results in a pulp more suitable for feeding the refiner; it eliminates the breaker-beater and reduces manpower necessary. Dr. Aronovsky mentioned the possibility of using a hammermill between the cooker and refiner to shorten the particles of cooked straw delivered to the refiner.

G. C. Johnston (Waldorf Paper Products Co.) inquired regarding the capacity of the roll press. Mr. Herman replied that the 24- × 54-in. rolls can handle 148 tons per 8 hours or approximately 400 tons per day. Of course, closer setting of the rolls for greater moisture removal reduces the production from these presses. The pulp which enters at about 15% solids will be discharged at 40 to 45% solids. The degree of dewatering varies some with the different pulps. Hydrapulper straw pulp fed into the press at 12% came out at 52% dry at the rate of 8 tons per hour.

T. W. Stanley (Dresden Paper Mills Co.) discussed the need for proper cooking and refining to obtain a good level sheet and, in turn, a good corrugated box. He stated that sodium sulphite-cooked straw does not give a level sheet, i.e., a paper with sufficiently uniform formation. H. J. Shatto's (Fort Wayne Corrugated Paper Co.) experience with sulphite pulping was apparently different, since he found that neutral sulphite-cooked pulp is better than that prepared with caustic soda or with a caustic-soda ash mixture. The neutral sulphite pulp gives, on the average, a somewhat longer fiber. Laboratory control tests in this mill show that the Riehle crush test is practically the same whether the sheet is made from a free or from a slow stock. The slow stock, however, tends to give trouble on the corrugating machine, producing high and low flutes and resulting in "fluffing out" on the corrugator. Free stock (650 to 700 ml. Schopper-Riegler) seems to run better both on the paper machine and in the corrugator. Mr. Agronin noted that a mill using another agricultural residue employs the de Montigny fiber length test in place of the freeness test. That particular mill claims a 25% increase in quality brought about by using this fiber length test for control. Mr. Agronin suggested that this test might be suitable for control in strawboard production. V. E. Bush (Hinde and Dauch Paper Co.) said that from a practical angle there seemed to be a definite relationship between slowness of machine furnish and stiffness of the finished paper. J. G. McFarland (Central Fibre Products Co.) stated that both fiber length and uniformity

are important. Elimination of the extremely long fiber bundles and of the fines generally results in a better pulp. Paper produced on machines which are partly "limed up" are difficult to corrugate uniformly.

N. F. Wilson (Alton Box Board Co.) stated that they are using neutral sulphite for pulping at the Carlyle mill which has a closed liquor system. The sulphite stock which is normally near neutral apparently works best in such a system. However, they are also using a small amount of caustic along with the neutral sodium sulphite to improve the strength characteristics of the pulps. Factors including the type of cook, degree and type of refining, and the conditions of paper machine operation all tie in to govern the stiffness of the corrugating paper. Mr. Wilson also said that it is undesirable to obtain hydration of the stock chemically, i.e., it is better to cook straw on the raw side and put more work into refining to obtain the desired hydration. Fiber length seems to be directly related to the degree of hydration of the stock. Beating an unwashed caustic pulp gives paper with good stiffness, but the stock is too slow for obtaining high production. If the alkali and the fines are removed by good washing, a pulp with more uniform fiber length can be obtained and a paper with good stiffness results. Mr. Wilson claims that the degree of stiffness can be predicted by fiber length examination with a microscope.

Meeting of TAPPI Fibrous Agricultural Residue Committee, Tuesday, November 8

Dr. Aronovsky gave a brief summation of the discussions at the last meeting of the whole Committee at Peoria in November, 1948. He then called on H. M. Blandin (Central Fibre Products Co.) for a report on the progress made on straw preservation. Mr. Blandin stated that most of the mills who had used borax as a preservative for the ricked straw bales reported satisfactory results. Some mills put some borax on the bales of the third tier from the top as well as on the top two tiers, particularly on those ricks which were to be kept for more than one year. He then asked C. W. White (Pacific Coast Borax Co.) to show some colored photographic slides of treated and untreated ricks. These slides showed quite clearly that bales on the top of a rick treated with borax were as firm as when they were put up. On the other hand, a man standing on the top of an untreated rick sank almost to his waist in the rotted straw. It was interesting to see that straw which had received a rather high concentration of borax had the bright yellow color of unweathered new straw, while adjacent areas which had not received much borax had the dark gray appearance of weathered straw. Straw bales on top of the ricks which had received a fairly uniform sprinkling of the borax had a weathered appearance even though the straw was still well preserved.

In discussing straw preservation, Mr. Burns wanted to know how to arrive at an estimate of the savings due to preservation with borax, in order to justify the expense of treating the straw with this material. He suggested the need for a standardized procedure for a mill study of this problem. Dr. Lathrop stated that the financial loss would probably be greater than just the cost of the straw itself, since handling costs of badly weathered straw are quite high. Mr. Krancher indicated that his mill never cooks weathered straw by itself; therefore, loss estimates with any degree of accuracy are practically impossible. Mr. U. C. Wisman (Central Fibre Products Co.) said that the density of the bale must not be overlooked in estimating the cost of preservation, since bales weighing 70 pounds or more would be less apt to weather readily, and would, therefore, require less borax.

Mr. White stated that 1500 pounds of borax or borascu (a crude grade of borax) can be fairly well distributed on the top surface of a rick, 50 × 66 ft., with a shovel. The particle size of borascu is similar to that of ordinary granulated sugar. Dr. Aronovsky suggested the use of a small lawn seed spreader, but Mr. White replied that this had been tried and abandoned due to the difficulty of running such a spreader over the very uneven top surface of the rick. Mr. Krancher also stated that this would not be practical on a rick with a pyramidal top. J. A. Belford (Ball Brothers Co.) used a 4-mesh wire cloth through which the borascu was distributed evenly on the steps of the pyramidal top. Mr. White pointed out that a cyclone seeder could be used but the present types of such seeders would not take a full 100-pound bag of the preservative. However, this seeder was able to spread the borascu uniformly right up to the edge of the rick. E. R. Carpenter (Terre Haute Paper Co.) suggested spraying the rick with a solution of borax. The opinion of the group was that this would require too much water since borax is not very soluble. Furthermore, it is the relatively low solubility of borax which is needed to carry the preservative effects throughout a year's storage.

As a means of determining roughly the amount of deterioration which took place in the stored straw, Dr. Aronovsky suggested using the 1% sodium hydroxide solubility test. Mr. Price stated that he had run both alkali and water solubility tests with the following results: the top bales of a borax-treated rick, two years old, had an alkali solubility of 40.6% and a water solubility of 12.0%; straw from bales 10 tiers down from the top had an alkali solubility of 31.1% and a water solubility of 7%; and new straw has an alkali solubility of 30% and a water solubility of 5–7%. Mr. Sutcliffe asked how far down the noticeable weathering went in an untreated rick. Mr. Wisman replied that little loss was noted in straw 5 tiers down from the top of an untreated rick after 2 years' standing. Denser bales, of course, will result in less rotting down in the stack.

In discussing the effect of rotted straw on the yields and qualities of the pulps produced, Dr. Aronovsky asked if the mills considered these losses important enough to justify separating the rotted from the sound straw and cooking them separately. He reported that work at the Northern Laboratory showed that sound straw gave a yield of 73% of pulp with a mullen of about 50. Slightly weathered straw produced a yield of 71% and a mullen strength of 40, whereas, a badly weathered bale yielded 57% pulp of a quality too low to give reliable mullen tests. Mr. Bush stated that they cooked the tops of the ricks separately from the rest of the straw, using a different cooking formula and time for sound and weathered straws, and blending the pulps in suitable proportions for the papermaking operation. The results were surprisingly good. No troubles were encountered in machine operation or in the strength of the finished board. Mr. Shatto said that their experience in cooking the weathered straw separately from the sound straw gave results similar to those obtained by Mr. Bush. Mr. Krancher stated that more labor is required for handling weathered straw since the bales of weathered straw disintegrate quite easily. Mr. Shatto pointed out that it was easier for the men to handle the rotted straw separately than to handle the rotted and sound straw together.

Mr. Adair stated that the Alton Box Board Co. was looking into the possibility of aluminum roofs for their ricks. These roofs are estimated to cost $900 per 350-ton rick using 12-ft. × 14-ft. sheets of aluminum hinged in the center and reinforced with steel angles. He expects that these covers would last about 10 years, thus giving a cost of $90 per rick per year. Dr. Lathrop believed that the life of such aluminum plates would probably extend to 15 years. Mr. Bush stated that some of his straw ricks were covered with loose straw, and that these ricks held up better than some that were covered with sisal kraft paper. On ricks covered with paper, low spots tended to drain water into the rick and rapid evaporation of such water was hindered. In reply to Dr. Aronovsky's question, Mr. Bush said that loose straw would cost less than borax for covering the ricks, but the loose covering would not preserve the straw for as long a period. Mr. Burns in describing the use of sisal kraft covering on ricks in the mill yard stated that the original cover cost $162 per rick. The wire and blocks used to hold the cover in place can be used again, lowering the cost of the 2-year treatment to $140 per rick. Maintenance of such covering is necessary after each windstorm but the straw remains well preserved and dry when properly covered. It was the consensus of the group that a study be made to determine the relative costs of preservation and an estimate of the savings to the mills from the reduction in the amounts of weathered straw. Mr. Blandin, chairman, and other members of the subcommittee on straw preservation will carry out this study.

On the topic of straw procurement, Mr. Adair stated that they have obtained most of their straw within a 50-mile radius. They have about 15,000 tons stored in ricks on farm sites and have purchased very little straw into their yard. The purchase price was $14 for straw within a 50-mile radius, and $12 for straw within 25 miles of the mill. The availability of more and better baling machines resulted in filling the straw requirements of the Alton Box Board Co. by August 1.

J. A. Belford reported that their straw purchasing program was also completed early, with most of their straw stacked in the field. A large proportion of the straw purchased by Mr. Belford was in the form of high density, 17- × 22-in., 100-pound bales using 3-wire galvanized ties. Their losses in untreated ricks of

dense bales were exceptionally low. Reporting for the Fort Wayne Corrugating Paper Co., E. W. Klepfer stated that he purchased all of the straw that they needed, with most of it delivered by truck. Mr. Klepfer said that more field equipment was in use, resulting in cleaner straw of better quality, in spite of a rainy spell at harvest time. He also reported that string-tied bales are becoming unpopular. Mr. Wisman said that in spite of untimely rains, the Central Fibre Products Co. had obtained all the straw that they needed. Mr. Wisman pointed out that rapid baling is necessary because in some areas, particularly in Kansas, the farmers plow when moisture conditions are right regardless of straw removal. He considered that the delivered price of $7 per ton, quoted by C. E. Grothaus of the University of Kansas Research Foundation in his report, "Pulp and Paper from Kansas Straw," was too low. Dr. Grothaus explained that he was quoting from a memorandum by the Bureau of Business Research from the University of Kansas, and that he knew of one operator who delivered a fairly large amount of straw at that price.

Conditions for straw procurement were better this year although rains in June and July bothered them some, according to V. E. Bush. He obtained a limited amount of straw from Nebraska because local conditions did not appear promising at first. A high-density bale is better from every standpoint, and he has obtained more 80-pound bales this year than before. He paid $14 per ton for a limited amount of straw in an isolated section about 100 miles from the mill; the rest of the straw was purchased at $12 per ton. Mr. Lyon (Terre Haute Paper Co.) stated they have 25,000 tons of straw in their yard. Mr. Owen said that all of the required straw for their Sandusky mills was trucked in and that they have purchased all of the straw they need at a reasonable figure. The River Raisin Paper Co. has an adequate supply of straw in field ricks according to M. F. Knack. Some of the straw, however, is weedy. The supply of straw for the three mills in the Coshocton, Ohio, area was good according to G. A. Dunlop, who stated that they were not buying much straw this year. Speaking for the only strawboard mill in Canada, W. H. Palm (Hinde and Dauch Paper Co. of Canada Ltd.) said that they had a good season this year. They purchase mostly binder-thrashed straw in 100-pound bales. The high density of the bales and the weather conditions at Trenton, Ont., results in relatively little deterioration of their ricked straw. Only the top layer of the straw rick is affected to some extent. Mr. Palm said that they are preparing to chop the straw going into the mill. They have purchased a straw chopper and have developed a bale breaker at the mill. This company expects to operate the mill on chopped straw early in 1950.

Mr. Adair stated that in their straw purchasing area, there was a decrease of 25% in the planted wheat acreage due to the weather and to smaller acreage allocation of some farmers. Dr. Lathrop mentioned that Clinton oats straw gave good results in preliminary work at the Laboratory. Mr. Wisman then asked if the chemical requirements were reduced for Clinton oats since his company had reported lower yield and poorer paper from this straw.

Reporting for the subcommittee on fiber classification, Dr. Aronovsky said that the soft winter wheat straw gave the best results in laboratory work so far. A few preliminary experiments showed that Clinton oats straw was fully equal to the soft winter wheat straw. Nebraska and Kansas straw and the white western straw gave somewhat lower pulp yields and strength properties as compared with the soft winter wheat and the Clinton oats straws. According to Mr. Burns, experience at his mill indicated that Clinton oats straw weathered easily giving a low pulp yield and a soft sheet similar to that from the other oats straws. Mr. Shatto concurred with Mr. Burns' statement.

Reporting for the subcommittee on testing, N. F. Wilson stated that most of his time on this committee work was centered about the design of a laboratory corrugator, which he demonstrated to the group. In answer to several questions, Mr. Wilson said that the results with this laboratory corrugator would not necessarily be of the same magnitude as obtained with large mill equipment, but he believed that it would give a better indication of corrugating properties of the paper than the Riehle or Hinde and Dauch crush tests. The model which he exhibited was only a crude one and he expects to improve this model and have it completed for exhibiting at the annual TAPPI meeting in February. He expects that he might also have some preliminary data on the correlation of this laboratory unit with large-scale corrugating to report at that time. Mr. Wilson classified board tests in three groups: a poor board gives an 8–25 pound flat crush test, a fair board gives 25–35 pounds, and a good board gives 35–50 pounds per square inch on finished corrugated board with C flute. Higher results are obtained with B flute and lower with A flute corrugating.

Mr. Krancher stated that the customers demand a crush test of 5,000 pounds per square foot (about 35 pounds per square inch). They would prefer a board with a 6,000 pound test to run at 350 to 400 feet per minute on the corrugator. The average speed of corrugator operation is 250 feet per minute. Mr. Fiori said that an improved crush test is obtained at a lower running speed on the corrugator. An all-bogus sheet runs easily at 400 feet per minute while strawboard gives trouble at 350 feet per minute but runs well at 300 feet per minute. With kraft corrugating board, the corrugator can run 500 feet per minute giving a crush test of 6,000 pounds per square foot. Mr. Krancher reported that while there is no very close correlation between Riehle test on the corrugating paper and the flat crush test on the finished double-faced board, corrugating paper with a high Riehle will generally result in a higher flat crush test.

In reporting for the subcommittee on pulping, B. F. Stahl (Terre Haute Paper Co.) distributed copies of a table which he prepared, based on the information received from nine mills, on the method of calculating yields of straw pulp in commercial operation. This project was set up to determine the methods used to calculate yield by the different mills, and to try to develop a standard method for all of the mills. The data were incomplete because some mills had not as yet replied to the questionnaire sent out by Mr. Stahl, and some had not given all the required figures. After some discussion, it was decided that Mr. Stahl would contact these mills again, and he will prepare a complete report on this project at the annual TAPPI meeting.

Plans for the annual meeting were discussed, and it was decided that this Committee would have a technical session at the February meeting. Papers to be presented at this session will be a preliminary report on the results of preservation work to date including some figures on the cost of preservation and on the savings effected, a paper by J. E. Atchison on straw pulping and papermaking in Europe, a paper by D. E. Bloodgood of Purdue University on pilot-plant studies of reducing stream pollution carried out at the Terre Haute mill, a report on the laboratory corrugator to include a demonstration of the apparatus, and a completed report on the mill methods of calculating yield from straw pulping. A meeting of the members of the Fibrous Agricultural Residues Committee will also be held.

On Monday afternoon, November 7, demonstrations of producing both strawboard pulp and bleachable straw soda pulp were carried out in a 3-foot Hydrapulper in the laboratory of the Terre Haute Paper Co. All of the members of this group who had not previously seen this method of pulping were considerably surprised at the speed of pulping and at the qualities of the straw pulps produced. Between runs in the Hydrapulper, the members toured the pulp and paper mill of the Terre Haute Paper Co. At the group luncheon on Monday, J. E. Atchison, chief of the pulp and paper section of ECA, gave a brief talk on "Some Observations on the European Paper Industry." He pointed out that straw pulp is used as a constituent of most of the papers produced in Europe, from coarse wrapping and boxboard paper to the better grades of fine papers. The mills and processes are antiquated, as compared with North American practice, and every mill has its own manufacturing secrets. Dr. Atchison indicated that attempts are being made to organize a technical association similar to TAPPI in western Europe.

On Monday evening the whole group was entertained at a complimentary reception and dinner given by the Terre Haute Paper Co. R. G. Macdonald, national secretary of TAPPI, gave a brief talk on the relationship of the activities of TAPPI and of the TAPPI committees to the industry. He dwelt particularly on the Fibrous Agricultural Residues Committee which he stated was actually an association within the Association. He was quite pleased with the frankness of the discussions at this meeting and stated that the strawboard industry would gain materially from the work and meetings of this Committee. Ward S. Hubbard, President of the Terre Haute Paper Co. greeted the group cordially and said he was very pleased to have the Terre Haute Paper Co. as host to this meeting. W. P. Allyn, head of the zoology department, Indiana State Teachers College,

Terre Haute, Ind., then gave an excellent, humorous talk on the "Blue Ribbon Age of America" which was enjoyed and appreciated by all present. After the meeting of the TAPPI Fibrous Agricultural Residues Committee on Tuesday morning, November 8, the members present visited the Terre Haute Brewing Co. and the penicillin plant and research laboratory of the Commercial Solvents Corp.

About 75 people attended the technical session, pulping demonstration, committee meeting and the other activities on the program. All those who had attended previous meetings stated that the Terre Haute meeting was the best and most profitable and enjoyable to date. Nearly everyone present joined in the lively discussions at the technical session and committee meeting. Those who had attended the 1948 meeting at Peoria for the first time came to the Terre Haute meeting. A good deal of the credit for the success of this meeting is due to the hospitality of the Terre Haute Paper Co. and its officers in helping develop the program and in providing the facilities for carrying it out. Particular thanks are due to R. F. Burns, vice-president and production manager, and to his assistants of the Terre Haute Paper Co. Many comments were heard on the excellence of the program and on its organization and successful execution. Nearly everyone present indicated that they would be on hand for the fall 1950 meeting of this committee.

S. I. Aronovsky, *Chairman,*
TAPPI Fibrous Agricultural Residues Committee

Technology in the Japanese Pulp and Paper Industry

HAROLD R. MURDOCK

The world is out of control. Never before did so many people have so many divergent ideas as to how they should get along together. The earlier methods of evaluating the social and economic relations of man mean almost nothing today. This problem is accentuated in the Far East where such an understanding is fundamental to the future welfare of the Japanese people.

On August 15, 1945, all America celebrated the victory over Japan. In New York City, the jamming, shuffling crowds on the streets were ankle deep in torn paper which had been tossed from the windows of the skyscrapers. The paper had floated to the streets during the holiday celebration like a veritable paper snow storm. This paper was not entirely the residues from wastepaper baskets and used newspapers. Many enthusiastic offices actually tore up their unused writing and tissue papers in order to give added vent to their enthusiasm. The next day, the Sanitary Department of New York City reported that they had collected 5438 tons of wastepaper from these streets. The people of the United States appear to have considered paper a plentiful and cheap commodity.

But let us look at the other side of the story. Japan, now a defeated nation, was struggling over many difficulties to produce 3631 tons of paper of all kinds during the same eventful month of August, 1945. In other words, Japan was able to produce in one month only about two-thirds of the paper wasted in New York City in that one day of victory celebration. The contrast could not be more spectacular. The Americans on V-J Day cared little about the welfare of the Japanese, while today, we are spending millions of dollars trying to bring about the economic recovery of Japan.

When the Department of the Army, in June, 1946, asked me to go to Japan and assist General Douglas MacArthur in the recovery of the pulp and paper industry, it was difficult to obtain factual information. America knew little about the Japanese paper situation. Consequently, I entered upon an assignment relatively free of known complications and restrictions. I, also, was not acquainted with any of the personnel in the occupational forces and knew very little about the basic aims of this pioneering organization. I was starting on a brand new job, in a brand new country that operated in ways which were little understood by Americans.

General Douglas MacArthur is the Supreme Commander of the Allied Powers in the Far East. His title is usually abbreviated to SCAP. In Japan, the military aspects of occupation are assigned to the 8th U. S. Army. The overall problem relative to building a good society, economically, socially, and politically, are the responsibilities of SCAP's General Headquarters. The 8th Army also operates civil affairs teams in many localities throughout the four main islands of Japan in order to assist General Headquarters (GHQ) in obtaining pertinent data from the Japanese and to observe directly the influence of the occupation upon the Japanese people.

On October 2, 1945, the Natural Resources Section was established as a special staff section of General Headquarters to advise and inform SCAP on policies and activities pertaining to agriculture, fisheries, forestry, and mining in Japan. Responsibility for long-term planning and process technology in the pulp and paper industry was assigned to this section. Besides acting as Head of the Pulp and Paper Branch of this section, I served as a consultant to those other sections in GHQ who were primarily responsible for such activities as production, allocation, distribution, and price control.

Japan lost all of its possessions but the four original main islands—Hokkaido, Honshu, Shikoku, and Kyushu—as a result of World War II. These islands comprise a total land area of 91,051,500 acres. This land is approximately the size of the State of California but on it have to live over 80,000,000 people which is more than half the population of the entire United States. Japan is a mountainous country so that only 15,000,000 acres of land are capable of cultivation for agriculture. Current yields of foodstuffs are not sufficient to feed the population, although indigenous food supply is augmented with over 70 billion pounds of fish caught in adjacent waters. While Japan may succeed eventually, in producing a bare subsistence requirement, there appears to be no escape from the conclusion that some food will always have to be imported, particularly in the light of the net increase in population of more than 1,000,000 persons per year. Any indigenous increase in the domestic food production is of real interest to the American taxpayer who now pays over $1,000,000 a day for imported food essentials.

The forest resources of these four islands are not adequate to meet the economic levels desired for the Japanese, although 68% of Japan is considered to be forest land as compared to the 16% suitable for agriculture. Because of excessive demands for wood since 1937, Japan has been rather consistently overcutting its forests. Today, informed sources believe that the Japanese are consuming twice as much wood as is growing each year. Consequently, conservation of timber, pulpwood, mine props, and fuelwood are of great importance.

The Oji Paper Manufacturing Co. produced over 85% of the paper and 95% of the wood pulp consumed in Japan before World War II. Because of this, there was no overall technical organization in the industry. This company obtained its technology from other countries, either by studying the literature from these countries or by actual visits to the United States, Canadian, and Scandinavian mills. The chemist and engineer in Japan were poorly paid, given little encouragement, and rarely did he ever reach an important position within the organization. Advancement

Harold R. Murdock, Head of Pulp and Paper Branch NRS, GHQ, SCAP from Sept., 1946 until Aug., 1949; now Chemical Process Engineer, Robert & Co. Assoc., Atlanta, Ga.

was based more upon time employed rather than ability. Even in the Oji Co., technical men in one mill never visited other mills of the company and were seldom able to learn about the company operations other than their own assignment. Research was negligible, but ability to copy foreign methods and processes as the means for keeping up to competition, was at high level.

These conclusions were reached in the first few months after my arrival, but because of a small staff, we could not tackle all the existing problems. It was expedient to select the fundamental urgent problems and solve them. A memorandum of the primary problems at that time records the following data:

1. Better utilization of pulpwood.
2. Better forest management and reforestation plans.
3. Dissolution of the Oji Paper Manufacturing Co. to strengthen competition within the industry.
4. Sponsorship of a technical organization to serve as a medium for educating those young members of the industry who have natural inclination toward science.
5. Increased pulp and paper production.

This was our plan in late 1946. Today, each of these projects has reached the status of having advised the Japanese in detail as to what should be done. Some projects have gone even further. Five mills are in full production of semichemical pulps. The Oji Paper Manufacturing Co. has been dissolved, and a healthy technical association has been established in the industry. Paper production today is twice that existing in 1945.

PAPER INDUSTRY

The war took its toll from the pulp and paper industry of Japan. Three of the larger paper mills were almost completely destroyed from bombing, followed by fire. A major rayon pulp mill and the second largest newsprint mill in Japan were dismantled by the military and converted into war plants. The rayon plant, after conversion, produced war chemicals, while the newsprint mill was converted to a plywood aircraft manufacturing plant. Only two airplanes are reported to have been completed. The greatest loss to the industry, was Karafuto and northern Korea where the most modern Japanese pulp mills existed. These were large kraft and sulphite pulp mills which used the spruce and fir forests adjacent to the mill site. Today, these mills are being operated by the Soviet Union.

The major production of paper in Japan is called foreign-style and simulates papers produced by other nations. In the peak production year of 1940, 1,467,146 short tons of foreign-style papers, 200,035 tons of Japanese-style, machinemade papers, and 35,853 tons of Japanese handmade papers were produced. Comparison of these figures with 1945 and 1948 shows the serious impairment in production due to the war, and the present recovery of the industry, which falls far short of the peak year of 1940.

Type of Paper	*1940*	*1945*	*1948*
Foreign-style	1,467,146	267,515	361,943
Japanese machine	200,035	21,965	105,448
Japanese hand	35,853	2,000	5,176
Total	1,703,034	291,480	472,567

The abrupt increase in Japanese machinemade papers in 1948 is due to their not being under price control. The shortage of printing papers created a market for Japanese Senka printing papers at prices three or more times the price of controlled foreign-style printing papers.

There were 534 foreign-style pulp and paper mills reported on January 1, 1949, as members of the Japanese Pulp and Paper Association: 54 were woodpulp mills only, 100 more were integrated mills with both pulp and paper production, while the balance of 380 mills produced either or both foreign-style papers and Japanese-style papers. The Japanese Hand Made Paper Association reported 8975 homes and factories producing handmade papers. It is estimated that around 3000 more homes in rural Japan are also producers of these handmade papers. Statistics for 1948 show that of all the above produces, only 24 pulp mills produce more than 5000 tons of pulp per year and only 9 paper mills manufacture more than 5000 tons of paper per year. The largest producing unit is the Tomakomai mill of the Oji Paper Manufacturing Co. in Hokkaido. In 1948, this mill accounted for more than 32% of paper production and more than 75% of newsprint production in Japan. It was started in 1910 to make Japan a selfsufficient nation in newsprint.

Groundwood, accounts for 58% of Japan's total pulp production, primarily because newsprint and other groundwood containing papers amount to over 60% of all the papers made in Japan: 410,347 short tons of groundwood were produced in the peak year 1941 in Japan proper, and 52,055 tons were manufactured in Karafuto which was lost to the Japanese at the end of the war. Eighty-four mills are reported today to have grinder installation. With but few exceptions, these mills have only one small pocket grinder. Today, Japan has 15 magazine grinders. The Tomakomai mill has eight of these magazine units besides 46 pocket grinders.

There are 17 sulphite pulp mills in Japan, eight of which are designed primarily to produce rayon quality pulps. The others have no bleach plants. Over 300,000 tons of unbleached sulphite could be produced from these mills, two-thirds of which could be bleached to rayon pulp. In general, the Japanese have Karlstad digester systems which are in good condition. With an ample pulpwood supply, these sulphite mills could assist greatly in meeting the paper demands in Japan.

There are five small kraft mills in Japan. Although they have been built since 1938 they are not modern from an American point of view. For instance, they use old Swedish rotary and stationary smelters to recover their chemicals. Furthermore, because of the shortage of salt cake they operate at low sulphidities and use substantial percentages of caustic soda as a make-up chemical.

The Japanese machinemade papers are little understood by the average foreigner. There are hundreds of small mills producing these papers. Outstanding in this production is the use of the tuberous roots of a Hibiscus plant called Torororoai. These roots are preserved in formaldehyde before maceration in water to produce an unusually thick jelly, which, when added to a pulp suspension, keeps the fibers flocculated so they can form soft textured sheets on a Yankee-type cylinder machine.

The fibers for the Japanese-style papers are also unique. Besides the use of some sulphite and groundwood, bast fiber from the mitsumata, silk mulberry, and kozo (often called paper mulberry) plants are used. Mitsumata was the sole fiber used in making currency papers before the war, when handmade methods were used exclusively. Silk mulberry fibers are the chief constituents of Japanese machinemade papers while Kozo is almost exclusively used for handmade paper production.

The foreigner who visits Japan is always enthusiastic over the beauty and uniqueness of Japanese handmade paper. Practically every village on the slopes of the mountains where agriculture is a marginal operation, is engaged in such paper production. These artisans had learned their trade from their fathers and grandfathers for many years. The war destroyed this link and consequently destroyed the perfection in the process. Some artisans were killed in the war, while others failed to return to their home after

the cessation of war activities. Because of this situation, Japanese papers no longer retain the beauty, permanence, and unique character of prewar days. The industry today is decadent, due to many causes. These difficulties can be overcome and handmade papers superior to prewar production can be produced when more careful attention is given to the use requirements of the papers and the preparation of the papermaking fibers. It has been fascinating to help these people who depend so much upon their paper production for their meager existence.

From the above, it is apparent that Japan has a wide variety of pulp and paper establishments. Given the pulpwood, chemicals and coal, the existing industry could produce sufficient pulp and paper of the present quality to meet the average paper consumption of prewar Japan.

Expansion of the industry and improvement in pulp and paper quality in order to meet external competition, will be found difficult in Japan. The industry is at least 15 years behind the rest of the world in applied technology. On many occasions, it has been necessary to decide, in fairness to the American pulp and paper industry, how much modern technology should be given to the Japanese. The occupational forces have had no explicit policy on this point. The decision was made that technical aid to the Japanese should be given only when such information helped the entire industry, and then only when the data could be placed into practice within a period of six months. This decision was found to be practical. During 1947 and 1948, increased production did not require new processes. Coal, chemicals, pulpwood, and transportation problems were then the vital factors. Today, the paper industry, if it is to improve quality, needs modern process methods. You will be impressed with the simplicity of some of the technological improvements we have already made in Japan. Material savings have been effected by introducing improved methods of processing pulpwood. One of these, a semichemical pulping process, adapted to present sulphite pulp mill equipment, yields one-third more pulp than the former process and gives considerably better quality papers. Another improvement was the addition of locally procured volcanic ash to pine pulp in order to overcome pitch difficulties in the manufacture of newsprint. Because of the shortage of salt cake in Japan, the kraft mills have had to resort to use caustic soda. Recommendations that the Japanese use sulphur in their kraft digesters improved quality and yield of pulp.

The lack of suitable modern testing equipment has created difficulties in establishing and maintaining specifications. One of the first projects was to establish specifications for papers in Japan, but existing equipment is so old and obsolete that it is almost impossible to place pulp and paper testing on the same basis as other countries. While importation of modern testing equipment used in Allied countries appears to be the most practical means of standardization, it involves the problem of obtaining dollars with which to purchase such equipment and better understanding by the Japanese regarding patent ability and trade rights of foreign equipment.

JAPANESE TECHNICAL ASSOCIATION

Early in 1947, it was suggested to the leading technical men in the industry, that they organize a technical association. There were men in the industry who had an inherent interest in the chemical and engineering aspects of pulp and processes, but they never had an opportunity to enter graduate school or to gather together formally to discuss their views on improving processes within the industry. A working group was appointed to study the matter. They borrowed a TAPPI Year Book to study the bylaws and constitution of our American organization. This group asked permission to adopt the membership classification and bylaws found in the TAPPI Year Book, and requested approval to use the name "Japanese TAPPI." This suggestion had wide acceptance with the Japanese so I assumed the responsibility of permitting the Japanese to use the name TAPPI. Membership increased rapidly. Today, there are over 1250 individual members in the organization and practically all of the leading producing companies are corporate members with no power to vote in the organization. Voting privileges rest entirely with the individual active members.

If there is a member of the American TAPPI who does not approve of the policy which I had to take, I am sure he would change his opinion if he could have attended one of the many technical symposiums held in Japan in the past year. I will always remember the discussion which followed the presentation of three papers on the semichemical acid sulphite pulp process. At the symposium, one of the speakers used a large chart on which was shown the conditions of cooking the wood in order to obtain good penetration, optimum yield, and pulp quality. During the discussion, one speaker from a small company went to the front of the room and superimposed his own cooking chart upon the chart of the company which once dominated the paper industry. There was keen interest and discussion over the differences in cooking the wood, but no evidence of ill feeling toward the competitive member writing upon another mill's chart. They were on common ground. They were in search of the truth. This shows how we are changing the thinking of these people.

This brief report on the Japanese pulp and paper industry fails in telling you the many interesting situations which I have enjoyed during the past three years. I have no reason to doubt the sincerity of the Japanese in wishing us to assist in stabilizing their industry. On many occasions we had divergent ideas as to how to overcome some of the problems. The Japanese showed clearly that they were as certain of their position as I was of my own. On such occasions, it was profitable to be patient and try to understand the Japanese point of view. When this was accomplished, it was a relatively easy matter to explain again what was on my mind. Rarely, after this deliberation, did we fail to agree. Some unfinished problems of this type remained when I left Japan. For example, Japan has 18 million tons of annual straws which could more than supply all the needs for paper in Japan with a lot left over. The Japanese have as yet not understood how to approach this problems, although from an American point of view, it has been explained to them clearly. I fully expect within the next few years, to hear that the Japanese are making a substantial amount of paper from their residual straws. It takes time for them to understand a new way of doing things, but I have confidence in their final analysis.

Presented at the Fall Meeting of the Technical Association of the Pulp & Paper Industry held at the Multonmah Hotel, Portland, Ore., Sept. 12-15, 1949.

Machine Production Possibilities

J. E. GOODWILLIE

In the time allotted today, I should like to present for consideration some thoughts as to the nature of the limitations on paper production imposed by present techniques. We say that a machine is limited to a certain maximum speed when running any particular sheet, and go on to specify that the limitation is imposed by some situation such as formation, drying capacity, or by some other condition prevailing on the machine in question. If

John E. Goodwillie, Beloit Iron Works, Beloit, Wis.

an arbitrary increase in machine speed results in impairment of quality due to formation, the speed increase is unprofitable because the paper cannot be sold. Or if the speed increase results in too many breaks or other deterioration in operating efficiency, the increase may actually result in a decrease in production. A third type of limitation is that of size or capacity, as insufficient driers to dry the sheet properly: here we have the subdivisions of limitation as to the steam pressure that is available for, or can be safely carried in the driers, and the limitation as to machine length or the space available. In most instances, the limiting factors can be modified or removed, and the production level of the machine consequently raised.

As a background for consideration, it may be helpful to mention some of the present day operating speed ranges for machines on various types of paper. It will be understood that these figures are for machines engineered and built particularly for the type and grade involved:

Greaseproof	450 to 550 f.p.m.
Sulphite papers	900 to 1200 f.p.m.
Groundwood types including machine coated	900 to 1200 f.p.m.
Newsprint	1400 to 1600 f.p.m.
Kraft container board	1200 to 1500 f.p.m.
Kraft paper	1400 to 1600 f.p.m.
Creped tissues	1500 to 2400 f.p.m.

From our observations machines in operation and taking into account changes in arrangement and design that seem fairly certain of successful incorporation into existing or new machine arrangements, we believe that speed ranges are not limited by any real barriers to further increase. In order to indicate the kind of planning necessary for advances into the higher speed ranges, we should like to make some comments on various sections of the fourdrinier machine but without attempting an evaluation of the results to be obtained from any change as it is obvious that the complexity of grades and characteristics would make a detailed analysis very lengthy indeed.

HEADBOX AND SLICE

If any paper mill group were to be canvassed on the question "What section of the fourdrinier machine imposes the greatest limitation to advance in production?", the majority would probably name the combination of distributor, headbox, and slice. For successful high-speed operation, it is well established that equipment of very substantial design is needed to avoid deflection or change in shape under the hydraulic pressures to be maintained, and, at the same time, a unit capable of precise and quite minute adjustment. Air entrained in the stock and water flow must be effectively handled; it will collect on headbox surfaces under velocity conditions that would seem certain to scour clean and, once formed into bubbles, tends to catch and form fibers in clots and strings that increase in size until they break loose and appear in the finished sheet. In addition to promoting formation of lumps, it is well known that air greatly accelerates slime formation on those surfaces against which it collects. Intermittent venting for air removal does not seem to be very effective and surprisingly large pockets will sometimes form and maintain their position quite close to a vent opening. All wetted surfaces must be readily accessible for cleaning. Last, and most important, there is the formidable hydraulic problem; the large combined flow of stock and water must be spread out to the full slice width without permitting formation of swirls or coarse turbulence and, at the same time, with a degree of uniform activity that will prevent stagnation and flocking in any part.

It will be sufficient to note here that in recent years much progress has been made in this section of machine design. Flow quantities of over 150 g.p.m. per inch of slice width are being effectively handled in heavy production machines with very satisfactory uniformity of weight distribution and test in the finished sheet. Attention is called to the fact that the enclosed headbox very probably will be widely used for high-speed machines and for many of more moderate speeds because the use of a combination of pressure and static head at the slice avoids the extremely high ponds that are necessary in headboxes using static head only. Experience indicates real advantages, in that stagnant areas and flocking are eliminated. In the older static headboxes, it was impossible to maintain a uniform velocity throughout the entire depth of flow, and it has been demonstrated that this lack of uniformity promotes the formation of swirls and eddies that tend to carry through to the wire. The enclosed slice, properly engineered, gives the opportunity to maintain uniform velocity conditions and also to control the velocity of the approach flow to the slice. In short, our experience with the enclosed slice and distributor makes us feel that it has removed the limitations that previously existed, in this section of the machine.

It is not enough to have good control of the flow from the slice at all speeds and quantities of flow, if we lose control after the flow has been released upon the moving wire. The greatest formation hazard while the sheet is on the fourdrinier wire comes, of course, in the first few feet of the table. The sheet is in a very fluid state, and rapid drainage tends to flood table rolls and cause more or less violent disturbances in the forming sheet. Arrangements to prevent this disturbance vary widely with machine speed and type of sheet being run, but information gained from various types of high-speed operation seem to indicate that this problem can be solved for any machine. Combinations of forming boards between breast roll and first table roll with carefully designed deflectors following most or all of the table rolls under the wire are very effective in disposing of most of the water that tends to flood the table roll nips. Dandy-type table rolls and special designs of grooved rolls have both been used very effectively.

For many types of sheet formation, varying degrees of pressure formation have proved to be most helpful in presetting the initial layer of stock on the wire before the flow actually leaves the slice, with a very definite improvement in conditions out on the fourdrinier table resulting.

WIRE SECTION

Still thinking of the fourdrinier table, the question of length of forming space has not imposed any evident limitation on further speed increases. Wire lengths of 130 feet, total, are being run efficiently on high-speed machines with no trouble either in wire changing or in actual operation. It is interesting to note that heavy-weight kraft machines running wires of approximately this length are now producing nearly 3.5 tons per day per inch of wire width, running at speeds within a few hundred feet of maximum newsprint machine speed. Also, that the newsprint machine production is now in the neighborhood of 1 ton per day per inch wire width. The wire length selected for any machine must obviously take into account the freeness of stock to be run, weight of sheet, and other factors, but it does appear that the length of fourdrinier wire need not impose a limitation on machine speed, at least not for some time to come.

Some of the most interesting problems in high-speed fourdrinier operation must be solved at the couch end of the fourdrinier wire. Here, in a very short space, we have the final dewatering of the sheet by high-vacuum application and the removal of the formed sheet from the wire. Successful high-speed operation depends upon effective separation of water, wire, and sheet with minimum tension or strain in the newly formed sheet. In order to appreciate

the difficulty of this separation on high-speed machines, we can consider the fact that some of the newsprint machines of three roll width are consuming 1000 hp. in batteries of vacuum pumps serving their couches. This investment in power and vacuum pump equipment is not being made primarily in the interest of a dryer sheet to the first press, because the 2 or 3% increase in dryness could be obtained much more economically in the press section. The investment is being made to secure a "harder" or safer draw from wire to press felt with consequent improvement in machine operating efficiency. The gain in efficiency evidently justifies the means, but it would seem that there must be some more economical approach to this problem. It would also appear that there must be a zone of diminishing returns from application of vacuum power alone and that a real limitation to further speed increases may be encountered at this position in the machine unless a different and better approach to the problem is found.

While the nature of this discussion does not permit of much elaboration, it should be mentioned that there are two main divisions in the problems encountered. First, there is the matter of complete separation of water removed by the suction couch and here the difficulty is that a conventional suction couch arrangement calls for removal of the sheet from the wire at the end of the vacuum area and at precisely the same point where water tends to throw from the roll back into the sheet. In a number of recent machine installations two separate couch rolls have been used, the first or primary couch being employed to do part of the work normally handled by the flat boxes as well as removing the bulk of the water that can be drawn from the sheet by vacuum action alone. Since the sheet remains on the fourdrinier wire as it leaves the primary couch, the vacuum box in the primary can be set in a manner to control positively the throw of water, with the result that this water is all delivered into a saveall positioned around the primary couch. The sheet is then removed from the wire after it has passed the main suction couch with its subsequent vacuum action, and experience with this two-couch arrangement indicates safer operation due to the fact that a great majority of the water handled was safely removed at the primary couch. Experience gained with primary couch installations then led to arrangements for certain types of sheets in which the sheet is removed from the run of the fourdrinier wire after it has passed the primary couch position but before it reaches the main couch position. These steps in development are mentioned in order to illustrate procedures for dealing with the matter of properly handling water removed from the sheet at the couch.

Even with effective water separation, higher speed operation on the lighter weight sheets imposes a relatively high stress in the newly formed sheet at the point where it is stripped from the wire. This has led to a consideration of means for automatic transfer of the sheet from the fourdrinier wire to the first press. In this connection, we feel that conventional use of the top pickup felt is not good enough because the action of this pickup felt depends upon running a fairly high moisture content in the felt and also upon limiting water removal from the sheet on the wire to a point such that the sheet will seal to the wet pickup felt at the point of contact. These factors mean that the first press must carry abnormally high water removal duty, has some effect upon the strength characteristics of the resulting sheet, and is generally not desirable for anything except tissue grades. Various types of transfer arrangements not requiring the wet pickup felt have been experimented with and placed in actual operation both in this country and abroad. Progress to date has been sufficient to make us feel sure that automatic transfer will be used on high-speed machines in the not distant future.

PRESSES

As machine speeds increase, the press-section equipment needs improvement. Obviously, the suction press must supplant the plain press for higher speeds, but even the suction press has its water removing ability affected by speed; without other changes, increases in speed tend to send a wetter sheet to the drier section and this is not only wasteful from the standpoint of steam usage but usually results in impaired sheet characteristics. Higher nip pressures tend to offset the effect of speed increases, and where operating conditions permit, this an ideal means to the end. The alternative is to employ an additional suction press, that is, the installation of a suction second press where only one had previously been used, and a suction third press where two had previously been used.

Modern press section equipment can be counted on to operate with high degrees of efficiency and when properly installed, should not impose any speed limitation.

DRIER SECTION

The drier section of a fourdrinier machine has physical size as a more dominant factor than any other part of the machine. Felt handling equipment, rope-carrier systems, doctor arrangements, all contribute to operating efficiency, and the ventilating equipment has a direct bearing on the capacity of the section, but the number of driers is still the dominating factor. For slower types of stock and specialty sheets, we are limited to comparatively low drier temperatures if the best characteristics are to be retained in the finished paper, and for these types we must install longer drier sections in order to develop the highest production possibilities.

On the freer types of stock and easier drying sheets, the use of higher steam pressure has been very effective. Operating steam pressures in the neighborhood of 100 pounds gage are becoming more common having been made possible by many improvements in machine design, the use of high-tensile iron for drier shells and heads, the development of condensate removal equipment suitable for both high-pressure and high-speed operation, and very careful attention to heat insulation and lubrication for the drier bearings. High-pressure drier operation with the attendant high temperatures has introduced problems in that these temperatures tend to cause drier shells to go out of round. It is therefore most important that the driers not only be safe for operation at the higher temperature levels, but also that they be capable of maintaining true running surfaces. Where doctors are run on drier surfaces this is especially critical, and operating experiences to date indicate that drier shells of high-tensile iron and of fairly substantial shell thickness give the best results. Comparatively recent metallurgical progress makes driers of this type available for operating steam pressures in excess of 150 pounds gage, where desirable.

Driers having shells and heads constructed from rolled steel, of various alloys, can be furnished for operation at steam pressures up to at least 200 pounds gage. The use of steel plate for fabrication of the drier shell introduces certain problems in connection with doctoring and with preserving true running surfaces, so that to date they have been principally useful where very high pressures are desirable. We might also mention the use of radiant heat and high-frequency electric drying. Outside of some very special drying problems, these heat sources seem to be of primary interest to augment the drying capacity of existing machines where space is very limited. It seems that any extensive use of these two types of drying would introduce problems from cockling, and that electric drying, in particular, would be quite expensive for general use.

As a further comment on cost of drying attention is called to the fact that high-pressure steam should be con-

sidered as a higher cost heating medium than steam at lower pressures. The difference in cost will vary with the power and steam balance situation in each mill, of course, but to indicate the possible magnitude we might mention a recent case where 50 cents per ton of production would have been chargeable if the drier section had been proportioned for 150 pounds operating pressure, in place of the 60-pound limit decided upon. This cost difference did not include allowance for the fact that the power house turbine through which the steam passed could not generate as many kilowatts at the higher back pressure.

REELS AND AUXILIARY EQUIPMENT

Progress has been made and still further improvements are in prospect for those machines handling papers requiring high finish and special treatment. It has been demonstrated that breaker presses installed in the drier section can be run at high speed and with good efficiency, and these can be of material assistance in developing good finish without the requirement for as much machine calendering as was previously considered necessary. Where size press treatment is required, proper attention to the arrangement of the press and particularly to provision for spreading the sheet as it passes to the following driers has made it possible to operate size presses efficiently in the speed ranges up toward 1000 f.p.m. In connection with special treatment on the paper machine, machine coating is being carried on successfully at speeds in the neighborhood of 1200 f.p.m. and it is believed that coating units can operate at speeds materially higher than this figure.

Some experience has recently been gained in supercalendering on the machine, and there is good reason to believe that supercalendering need not be carried on as a separate operation. This new arrangement will apparently run efficiently at any machine speed now contemplated and make very substantial savings in reduction of broke and labor charges. There is the possibility of extending this type of finish into paper grades where supercalendering is now not considered because of cost.

No limitations are evident in the reel and winder sections of fourdrinier machines. With modern reels, it is possible to build very sound rolls up to 84 inches in diameter on machines making the harder types of papers. On those types where special attention must be given to avoid corrugations in the reels, for example greaseproof and printing papers, the centerwind type of reel has proved very satisfactory and is evidently capable of handling any of the machine speeds in prospect.

DRIVES

In the preceding parts of this discussion, reference has been made at various points to machine efficiency and the effect of various design features on the efficiency of operation. All of these remarks presuppose that the fourdrinier machine is equipped with a drive that will accurately maintain the desired draw condition between the various sections and we feel it is obvious that a flexible and accurate drive is a prime necessity for good operating efficiency. For many years the relative merits of the mechanical drive and the sectional electric drive for paper machines has been argued, and we call attention to the fact that over this period of time, at least from the time when the enclosed spiral or hypoid drive units became available, the fundamental principles of the mechanical drive have remained unchanged while its various details have been progressively refined.

Today there are many machines equipped with mechanical drives through which as much as 1500 hp. is transmitted to the various sections of the machine which run steadily in the speed range from 1000 to 1500 f.p.m., and demonstrate very satisfactory operating efficiency. A number of these machines are called upon to manufacture a variety of sheet weights and types, and with these modern mechanical drives it is possible to change quickly and accurately from one grade to another, from one speed range to a quite different one, to operate at quite different total power requirements, and to do this without getting into difficulty requiring resetting of controls or juggling of draw adjustments beyond what is necessary to take care of the normal change in paper draw. The mechanical drive does not require specially trained personnel for its maintenance and, when properly designed and installed, will show a minimum maintenance cost per ton and minimum down time. Further improvements in design are now in prospect and it is believed that these will keep the mechanical drive a little ahead of any demands from the papermaking fraternity.

In concluding these remarks we can sum up the various comments offered with the statement of our belief that no section of the fourdrinier paper machine has in its characteristics a limitation to higher production rates and good operating efficiency. There is apparently no supersonic barrier to be crossed and we feel confident that each year will bring new developments and new production records.

Presented at the Fall Meeting of the Technical Association of the Pulp & Paper Industry held at the Multnomah Hotel, Portland, Ore., Sept. 12–15, 1949.

EMPLOYMENT SERVICE

Positions Open

P62-50. Man thoroughly experienced in the manufacture of twisted papers to establish a paper twisting department in a plant now engaged in processing hard fiber. Technical background preferred. Must know most modern machinery, twisting practices and market for twisted papers. Excellent opportunity in new enterprise in old established company.

P63-50. Technical service representative. Canadian citizen, French speaking, 30–40 years old. Technical training and some experience in paper manufacture. Canadian territory.

P64-50. Assistant Manager. Man experienced in fancy paper manufacture, preferably trained as a chemist, for coating mill in New England.

P65-50. Chemist. Young man with experience in coatings and paper for research in paper clays. Location—East Coast.

P66-50. Maintenance Engineer for Pacific Coast mill. To be in charge of all shops, department millwrights and pool of maintenance men. M.E. degree required and 15–20 years' experience both in shop and field. Excellent opportunity leading to plant engineers' position in three years.

P67-50. Chemist, experienced in pulp and paper field, excellent position and salary, long established, expanding company, manufacturing acid-proof materials.

Positions Wanted

E68-50. Engineer. 28, family. B.S. degree. 4 years' operating marine power plants. Several years sales engineer for instrumentation in pulp and paper mills. Desires position in either operation or mechanical department of Northern pulp and paper mill.

E69-50. Young chemical engineer with $3\frac{1}{2}$ years' experience in pulp and paper technical service. Desires position with progressive pulp and paper company.

E70-50. Chemical engineer. 38, family. Experience with manufacture of a wide variety of papers in Lithuania as chief chemist, superintendent, and mill manager. Speaks several languages fluently. Admitted to U. S. in 1949 as a D. P. Temporarily employed in sugar refinery. Desires to re-enter paper industry as soon as possible. Excellent mill training since 1936. Left Lithuania following Russian occupation.

E71-50. Graduate N. Y. State College of Forestry (paper course). 15 years' experience in technical control, research development, and sales service in board, coarse papers, and semichemical pulp. Desires production position in northeastern mill.

E72-50. Technically trained salesman to paper industry. Experience in variety of paper making jobs. Well-known in middle west. Fairly well-known in east, west, and south in sales capacity. Present range $10,000 and expenses.

GUIDE TO PROFESSIONAL SERVICES

KNOWLES ASSOCIATES
Consulting - Designing
ENGINEERS
Pulp and Paper Mills
BOwling Green 9-3456
19 RECTOR ST. NEW YORK 6, N. Y.

CHAS. T. MAIN, INC.
CONSULTING ENGINEERS
Process Studies, Design, Specifications and Engineering Supervision
PULP AND PAPER MILLS
Steam Hydraulic and Electrical Engineering
Reports, Consultation and Valuations
80 Federal Street Boston 10, Mass.

MYERS & ADDINGTON
Specialists for over 30 years in
INDUSTRIAL POWER PROBLEMS
ELECTRIC—STEAM—SURVEYS—DESIGNS
FOR
PULP AND PAPER MILLS
21 East 40th Street MUrray Hill
New York 16, N. Y. 6-4630

RODERICK O'DONOGHUE
CONSULTING ENGINEER
PULP MILLS—PAPER MILLS
IMPROVED PROCESSES—DESIGNS—REPORTS
420 Lexington Ave. New York 17, N. Y.

J. E. SIRRINE CO. *Engineers*
Greenville, S. C.
Est. 1902
Paper • Pulp Mills • Waste Disposal • Textile Mills • Appraisals • Water Plans • Steam Utilization • Steam Power Plants • Hydro-Electric • Reports

STADLER, HURTER & COMPANY
CONSULTING ENGINEERS
Specializing Since 1923 in
PULP AND PAPER MILLS
FROM FOREST TO FINISHED PRODUCTS
A. T. HURTER, M.E.I.C.
Suite 609
Drummond Building
Montreal, Canada
Represented in the U.S.A. by:
Stadler, Hurter & Co., Inc.
76 Beaver Street, New York 5, N. Y.
Phone: Whitehall 3-3881

FRANK C. VAUGHAN
Consulting Engineer
STUDIES, DESIGN, ESTIMATES, CONSTRUCTION, MANAGEMENT AND OPERATION
for
KRAFT, SEMI-CHEMICAL
PULP, PAPER AND STRUCTURAL BOARD MILLS
7th AND HOSPITAL STS. • RICHMOND, VA.

FREDERICK WIERK
CONSULTING ENGINEER
P. O. Box 492 Great Neck, N. Y.
Reports and Designs for Construction or Modernization of Pulp & Paper Mills, Steam and Hydro Power, **Stream Pollution Abatement.**

AMERICAN DEFIBRATOR, INC.
Consulting & Designing Engineers
WALLBOARD MILLS
CHRYSLER BUILDING • NEW YORK 17, N. Y.

Calendar of TAPPI Meetings

NATIONAL

Fundamental Research Conference: Chateau Frontenac, Quebec, P. Q., May 29–30, 1950. Symposium: "The Papermaking Properties of Fibers." (Joint Meeting with Technical Section, Canadian Pulp and Paper Association).

Second Testing Division Conference. Eastman Kodak Co. plant, Rochester, N. Y., September 13–15, 1950.

General Chairman—James D'A. Clark, Longview Wash.

Fibrous Materials Testing Committee—E. R. Schafer, Forest Products Laboratory, Madison, Wis., Chairman.

Nonfibrous Materials Testing Committee—J. P. Casey, New York State College of Forestry, Syracuse, N. Y., Chairman.

Wax Testing Committee—A. M. Heald, Marathon Corp., Menasha, Wis., Chairman.

Pulp Testing Committee—L. V. Forman, Institute of Paper Chemistry, Appleton, Wis., Chairman.

Optical Properties Committee—A. H. Croup, Hammermill Paper Co., Erie, Pa., Chairman.

Microscopy Committee—C. E. Brandon, Aetna Paper Co., Dayton, Ohio, Chairman.

Paper Testing Committee—A. K. Warner, Skinner & Sherman, Inc., 246 Stuart St., Boston, Mass., Chairman.

Container Testing Committee—W. J. Balster, Don L. Quinn Laboratories, Chicago, Ill., Chairman.

Chemical Methods Committee—Milton Fillius, Eastman Kodak Co., Chairman.

Packaging Materials Testing Committee—L. E. Simerl, Marathon Corp., Menasha, Wis., Chairman.

Fifth Engineering Conference of the Pulp and Paper Industry. Netherland Plaza Hotel, Cincinnati, Ohio, October 2–5, 1950.

LOCAL SECTIONS

Delaware Valley Section:
May 25, 1950, Engineers Club, Philadelphia, Pa.

Maine-New Hampshire Section and New England Section:
June 23–24, 1950, Wentworth-by-the-Sea, Portsmouth, N. H.

Lake Erie Papermakers and Converters Assoc.:
May 19, 1950, Hickory Grille, Cleveland, Ohio

FOR PERMANENT MAXIMUM

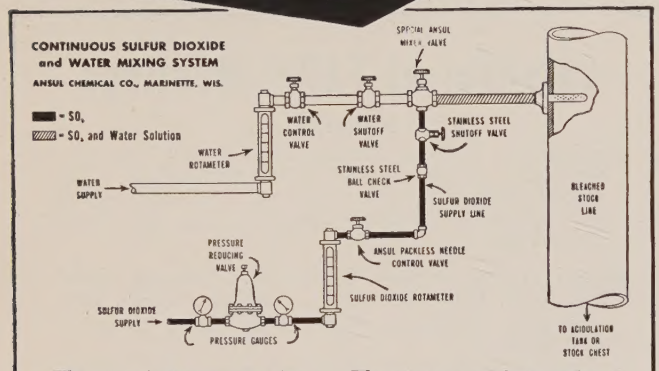
Brightness

in Bleached KRAFT Pulp

. . . INSTALL AN

ANSUL Constant SO_2

Concentration System . . . and get Positive Control of Acidulation



This Ansul System provides a continuous metered flow of sulfur dioxide and water solution at any desired concentration and rate of flow.

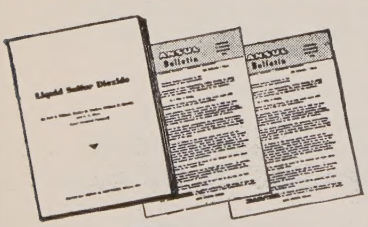
The solution may be introduced into the pulp at the acidulation tank, stock chest, the stock line from a washer, or at any suitable point in the bleaching system.

Ansul sulfur dioxide is an inexpensive acidifying agent . . . thoroughly efficient, and perfectly suited to the acidulation step in the preparation of bleached kraft pulp.

Ansul sulfur dioxide improves brightness and prevents color reversion because it:

1. Reduces colored ferric compounds to the soluble ferrous state so they may be easily washed from the pulp.
2. Bleaches and brightens the pulp by adjusting the pH to the acid side.
3. Acts as anti-chlor to remove residual chlorine and thus prevents formation of oxy-cellulose which would age to yellow compounds.
4. Permits dissolving of organic lime compounds so they may be removed by washing.

WRITE THE ANSUL TECHNICAL STAFF FOR FURTHER INFORMATION



Write today for these bulletins:
"A Method for Continually Preparing Sulfur Dioxide Solutions."
"Use of Sulfur Dioxide for Acidulation of Bleached Kraft Pulp."
Also, send for your copy of: "Liquid Sulfur Dioxide."

LIQUID Sulfur Dioxide by ANSUL

ANSUL CHEMICAL COMPANY
INDUSTRIAL CHEMICALS DIVISION, MARINETTE, WISCONSIN
60 E. 42nd St., New York—Lincoln-Liberty Bldg., Broad & Chestnut St., Philadelphia 7, Pa.

INDEX TO ADVERTISERS

American Cyanamid Co. ..... 8 A
Ansul Chemical Co. ..... 104 A
Appleton Wire Works ..... 36 A

Bagley & Sewall Co. ..... 15 A
Bauer Bros. Co. ..... 80 A
Beloit Iron Works ..... 1 A
Bird Machine Co. ..... 59 A
Black Clawson (Shartle, Dilts) ..... 33 A
Bristol Co., The ..... 65 A
Brown Co. ..... 49 A
Butterworth & Sons, H. W. ..... 82 A

Cameron Machine Co. ..... 71 A
Chicago Bridge & Iron Co. ..... 9 A
Ciba Co., The ..... 45 A
Combustion Engineering Co. ..... 61 A
Curlator Corp. ..... 63 A

De Laval Steam Turbine Co. ..... 73 A
Dicalite Div. (Great Lakes Carbon Corp.) ..... 83 A
Dorr Co. ..... 4 A
Dow Chemical Co. ..... 10 A
Draper Bros. Co. ..... 89 A
Du Pont de Nemours & Co., Inc., E. I. (Dyestuffs) ..... 51 A
Du Pont de Nemours & Co., Inc., E. I. (Electrochemicals) ..... 17 A
Du Pont de Nemours & Co., Inc., E. I. (Pigments) ..... 35 A

Eastwood-Nealley Corp. ..... 21 A

Farrel-Birmingham Co., Inc. ..... 43 A
Foster-Wheeler Corp. ..... 11 A

Geigy Co. ..... 84 A
General Dyestuff Corp. ..... 55 A
Glidden Co., The ..... 69 A
Grinnell Co., Inc. ..... 53 A
Gurley, W. & L. E. ..... 84 A

Hercules Powder Co. ..... 2nd Cover
Hermann Manufacturing Co. ..... 25 A
Huber Corp., J. M. ..... 12 A

Ingersoll-Rand Co. ..... 34 A

Johns-Manville Corp. ..... 3 A
Jones & Sons Co., E. D. ..... 77 A

Mallinckrodt Chemical Works ..... 84 A
Manhattan Rubber Div. (Raybestos-Manhattan Inc.) ..... 75 A
Morden Machines Co. ..... 56 A

National Aluminate Corp. ..... 27 A
National Aniline Div. ..... 2 A
Niagara Alkali Co. ..... 39 A

Oakite Products, Inc. ..... 90 A

Paper & Industrial Appliances, Inc. ..... 47 A
Penick & Ford Ltd., Inc. ..... 40 A
Pennsylvania Salt Mfg. Co. ..... 79 A
Perkins & Son, Inc., B. F. ..... 41 A
Perkins-Goodwin Co. ..... 4th Cover
Pusey & Jones Corp. ..... 23 A

Rice Barton Corp. ..... 67 A
Rohm & Haas Co. ..... 37 A
Ross Engineering Corp., J. O. ..... 13 A

Sandy Hill Iron & Brass Works ..... 54 A
Sindar Corp. ..... 81 A
Socony-Vacuum Oil Co., Inc. ..... 29 A
Sprout, Waldron & Co. ..... 3rd Cover
Stebbins Engineering & Mfg. Co. ..... 40 A

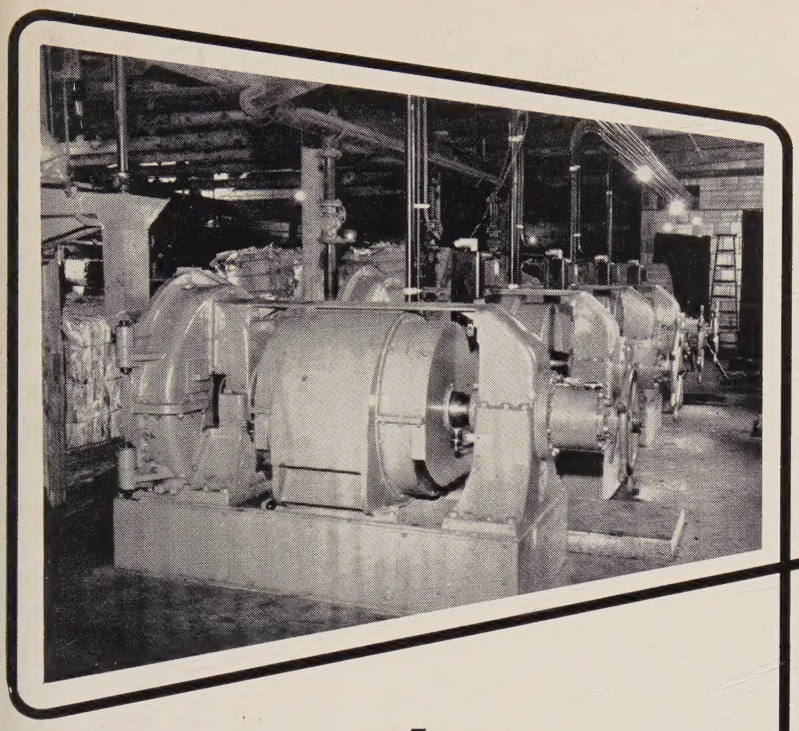
Testing Machines, Inc. ..... 92 A
Texas Gulf Sulphur Co. ..... 46 A

Vanderbilt Co., R. T. ..... 7 A

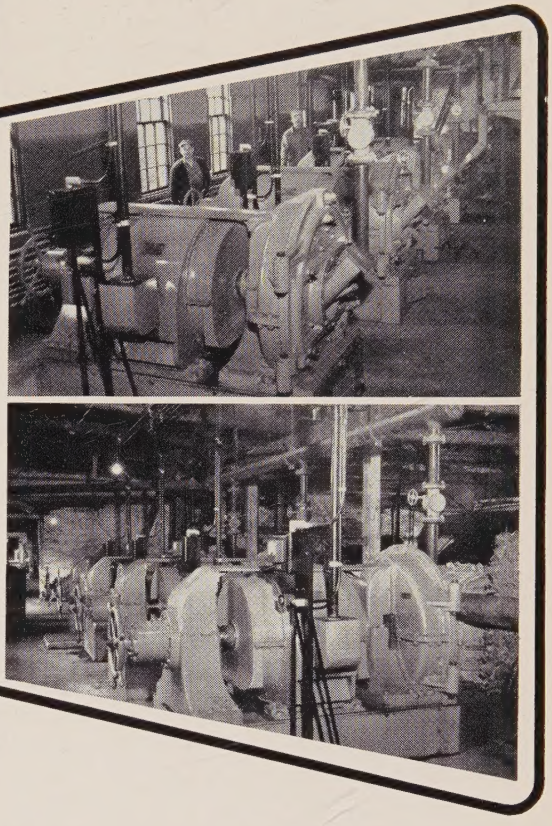
Wallace & Tiernan Co., Inc. ..... 31 A
Wallerstein Co. ..... 91 A
Westinghouse Electric Corp. 18A–19A

PROFESSIONAL SERVICES

American Defibrator Co. ..... 103 A
Knowles Associates ..... 103 A
Main, Chas. T., Inc. ..... 103 A
Myers & Addington ..... 103 A
O'Donoghue, Roderick ..... 103 A
Sirrine & Co., J. E. ..... 103 A
Stadler Hurter & Co., Ltd. ..... 103 A
Vaughan, Frank C. ..... 103 A
Wierk, Frederick ..... 103 A



Mills that compare Refiners



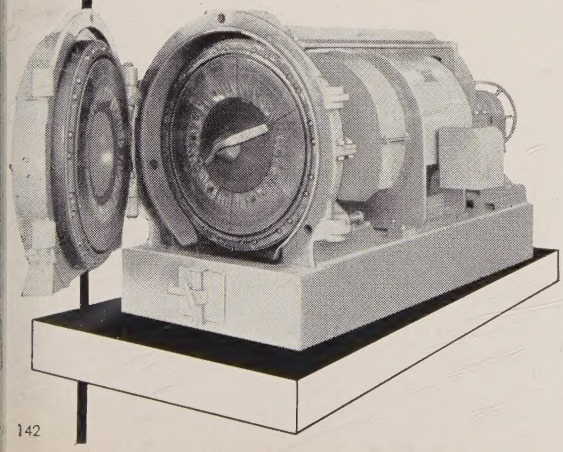
choose

Sprout-Waldron

THE OTSEGO FALLS INSTALLATION

Photographs showing a battery of S/W Refiners installed at the Otsego Falls Paper Mills, Inc. Otsego, Mich.

S/W Refiners do a wide variety of jobs—all of them thoroughly and economically. Here are some applications: refining kraft, soda, and sulphite knotter and fine screen rejects; hogged bull screen rejects; knotter and second screen rejects of raw groundwood; *semi-chemical chips of all kinds;* spent chips after extraction process; bagasse, straw, and similar grasses; breaking down lumps in reclaimed waste paper stock; reduction and refining of rag and other half stocks, etc., etc.



Sprout-Waldron Refiners do an excellent job in any kind of pulping, but in semichemical operations they far outperform similar equipment. They do more, do it better, and at less cost.

Their unique peripheral control ring feature provides great flexibility of adjustment which enables mills to produce a wide variety of pulp characteristics. With the Sprout-Waldron you can pinpoint exact pulp requirements. Rugged, long-wearing plates are available in many styles. They are easily changed, and are inexpensive.

These precision engineered Refiners involve a comparatively low initial investment. Additional savings are achieved through high production rates, economy in power consumption, ease of operation and maintenance.

A Sprout-Waldron representative will be glad to explain how these Refiners can increase your output and save on operating costs. Write for Bulletin 41 which contains pertinent data on this equipment and how it can serve your needs. Sprout, Waldron & Co., Inc., 38 Waldron St., Muncy, Penna.

Sprout, Waldron

Manufacturing Engineers

SINCE 1866

MUNCY • PENNSYLVANIA

PULP

Perkins-Goodwin Co.

Established 1846

30 ROCKEFELLER PLAZA, NEW YORK

CHICAGO, ILLINOIS · LUFKIN, TEXAS · STOCKHOLM, SWED

PAPER